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NUCLEAR SCIENCE ABSTRACTS

Volume 17 Number 3

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February 15, 1963

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Volume 17, Number 3, February 15, 1963

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Volume 17, Number 3 February 15, 1963

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

2656 (AD-274727L) DESIGN AND ANALYSIS OF UNDERGROUND REINFORCED-CONCRETE ARCHES. Technical Report No. 2-590. W. J. Flathau, R. A. Sager, and F. A. Luzi (Waterways Experiment Station, Vicksburg, Miss.). Jan. 1962. 137p.

Fixed-end and two-hinged arches of various radii and thicknesses were exposed to ground-surface air-overpressures resulting from 40 KT and 20 MT weapons. Comparisons were made of 6 different loading methods used to predict the ground-surface air-overpressure required to cause collapse of underground arches. Results showed that the Equivalent Surcharge method that assumes failure at the threshold of the compression regime appeared to be the most adequate for the design of buried arch-type structures located above the ground-water table, while the Uniform Compression mode loading is recommended for structures located below the ground-water table. Buried arches of the type discussed can withstand overpressures of at least 50 psi, regardless of weapon size, when designed to withstand dead loads alone using standard design strengths for steel and concrete. A procedure for predicting the magnitude of nuclear radiation within buried structures is also presented. (C.H.)

2657 (AD-276392) SHELTER FROM FALLOUT. E. D. Callahan, L. Rosenblum, and J. R. Coombe (Technical Operations, Inc., Burlington, Mass.). Revised Apr. 7, 1961. Contract CDM-SR-59-33. 99p. (TO-B-60-30)

A survey is presented of the existing fallout shelter potential in basements and mines in the United States, and in boats on bodies of water of sufficient size and depth. Also presented is an analysis of the design, construction, and habitability of a minimum-type, improvised home basement family fallout shelter, and the shelter potential in an actual suburban community in the Northeast. The survey shows that about 60% of the population in the U. S. would have access to basement shelter, with the figures ranging from better than 80% in OCDM regions 1, 2, and 4 to less than 20% in regions 3, 5, and 7. Mine shelter could be an important shelter resource for two to four million people in some 16 states. A family-size, sand-bag fallout shelter can be readily constructed in the basement corner by one person for a materials' cost of about $60. The shelter, which offers a protection factor of 100 against outside radiation levels, can be assembled in an hour if the materials are suitably stored along the basement walls, and realistic excursion schedules appear possible after two days even in the heaviest fallout areas. A survey of public and private buildings in a typical northeastern suburban city of 25,000 population indicated that the basements of schools, churches, and other large buildings do not offer significantly better protection than that of the average home basement (i.e., about a factor of 20). (auth)

2658 (AFSWC-TDR-61-93) GEOLOGIC STRUCTURE STABILITY AND DEEP PROTECTION CONSTRUCTION. G. B. Clark and R. D. Caudle (Missouri. Univ., Rolla. School of Mines and Metallurgy). Nov. 1961. Contract AF29(601)-2821. 619p. (AD-274825)

A study was made of the problems associated with protective construction in rock, particularly deep protective structures. Information from the experience of mining engineers and from past weapons tests is given on rock structure and properties and on theories relating these to the stability of underground openings under both static and dynamic loads. Recommendations are made for meeting design problems for underground protective structures and for research to improve the reliability of the designs. (auth)

2659 (AFSWC-TR-61-90) STUDIES OF RESPONSE OF ARCHES AND DOMES UNDER DYNAMIC LOADS. T. Huang, S. Iyengar, and R. L. Jennings (Illinois. Univ., Urbana). Oct. 1961. Contract AF29(601)-2501. 76p. (AD-27690)

The accuracy of an approximate design method for arches subjected to dynamic loads is evaluated by comparing the predictions of this method with the exact solutions. Primary emphasis is placed on the effects of loads which are uniformly distributed around the arch. The response of circular elastic arches under a moving pressure pulse is investigated by the modal method of analysis. Various combinations of natural modes are considered, and the combination of the smallest number of modes which satisfactorily approximates the exact solution is determined. It is concluded that good approximation to the true response can be obtained by considering the contributions of the first antisymmetrical and the first two symmetrical natural modes of vibration. A derivation is presented of an approximate theory for the dynamic response of spherical shells loaded unsymmetrically by time-varying pressures. Nonlinear effects are considered so that the resulting equations reflect the buckling tendencies associated with large-deflection behavior. (auth)

2660 (BRL-Memo-1390) INFORMATION SUMMARY OF BLAST PATTERNS IN TUNNELS AND CHAMBERS (SECOND EDITION). (Ballistics Research Labs., Aberdeen Proving Ground, Md.). Mar. 1962. 75p. (DASA-1273; AD-274228)

Military requirements for protective construction have in recent years included blast hardened designs. This often means putting the construction deep underground and sets up requirements for information on the behavior of blast

waves in confined regions such as tunnels and chambers. The Shock Tube Facility at the Ballistic Research Laboratories (BRL) endeavored to obtain information on the behavior of blast waves in tunnels and chambers by instrumenting models of simple tunnel configurations with piezoelectric gages and subjecting the models to the blast wave from shock tubes. Data were obtained from models attached to the 24 in. circular tube, the 4 × 15 in. rectangular tube, and the high pressure tube. A compilation of the test results is presented. (auth)

2661 (JAERI-6011) SITE DESCRIPTION AND RADIATION CONTROL OF THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. (Japan Atomic Energy Research Inst., Tokyo). May 1962. 52p. (In Japanese)

General features of the Japan Atomic Energy Research Institute are described. Topics discussed include meteorological and oceanographical conditions, population distribution in the area, agricultural and industrial use of land in the area, the electric power supply, the disposal of radioactive wastes, and the control of the release of gases into the atmosphere. (C.H.)

2662 (MLM-1135) MOUND LABORATORY MONTHLY PROGRESS REPORT FOR MARCH 1962. J. F. Eichelberger (Mound Lab., Miamisburg, Ohio). Mar. 30, 1962. Contract AT(33-1)-Gen-53. 26p.

In research on plastics, flow curve data were obtained on asbestos-filled diallyl phthalate formulations. The tensile properties of adhesive formulations after 26 weeks cure time are being tested. In development of radioelements, progress is reported in investigations of kinetics involved in Po(IV) reduction by ferrous iron and selective adsorption of trace elements. Development of separating and purifying processes is reported for Xe, H_2, and C. Work on the Ranger x-ray sensor was devoted to film casting techniques and Be metallography and deposition. Developmental work in Pu-bearing fuels is reported on techniques for differential thermal analysis, interfacial tension studies on liquids, cerium viscosity, Pu phase studies, and Pu-bearing glass. Developmental work in support of SNAP was devoted to welding, capsule design, source metallography, and recovery of U^{234}. Calorimetric measurements related to Ra^{223} half life are reported. Development of a program for reduction of spectrometric data is also reported. (J.R.D.)

2663 (NP-12210) LONG-RANGE PROGRAM ON DEVELOPMENT AND UTILIZATION OF ATOMIC ENERGY. (Japan. Atomic Energy Commission, Tokyo). [1961]. 136p.

The long-range program on the development and utilization of atomic energy in Japan is discussed and evaluated. The program covers 20 years from 1961 to 1980. Of this period, the first 10 yr are considered as the stage of development, and the second 10 yr are considered the stage of practical progress. The programs apply to atomic energy generation, nuclear powered ships, nuclear fuel, and utilization of radiation. (N.W.R.)

2664 (ORNL-3334) PRODUCTION OF TRITIUM BY CONTAINED NUCLEAR EXPLOSIONS IN SALT: I. LABORATORY STUDIES OF ISOTOPIC EXCHANGE OF TRITIUM IN THE HYDROGEN–WATER SYSTEM. W. D. Bond (Oak Ridge National Lab., Tenn.). Dec. 6, 1962. Contract W-7405-eng-26. 20p.

The results of all exchange experiments suggest that tritium produced by a contained nuclear explosion will be mixed with environmental water. Tritium exchange in the reaction $HTO + H_2 \rightleftharpoons HT + H_2O$ was catalyzed at 600°C by a number of oxygenated salts that occur in salt formations. Calcium sulfate was the best catalyst, with values as high as 49 and 77% with pure $CaSO_4$ and Drierite, respectively, in deep bed tests. Even under diffusion-controlled conditions, where reactant gases were passed over fine powders of $CaSO_4$, exchanges were as high as 26% for residence times of 50 sec. Sodium chloride had no effect. At high temperatures in a plasma jet, with D_2 as a stand-in for T_2, exchange was very rapid. For 90 msec residence time and a D_2/H_2O feed ratio of 1.3, 53% of the water hydrogen exchanged with deuterium. (auth)

2665 (PNE-115F) TIMING AND FIRING. N. Hagopian and J. Kraemer (Edgerton, Germeshausen and Grier, Inc., Boston). Aug. 1962. Project GNOME. Contract [AT(29-1)-1183]. 58p.

All monitors at the control point indicated that the performance of the timing system was completely satisfactory on the live run. Basic to the instrumentation for the event were the special mobile control point built for the Plowshare Program and a timing station housed in a transportainer and located in the area adjacent to surface zero. Both hardwire and radio signals were transmitted to the experimenters. (auth)

2666 (WT-547) EFFECTS OF ATOMIC EXPLOSIONS ON THE IONOSPHERE. Fred B. Daniels and Arthur K. Harris (Signal Corps Engineering Labs., Fort Monmouth, N. J.). Jan. 1953. Project 9.4 [of] OPERATION SNAPPER. 61p.

Vertical and oblique incidence radio pulse soundings and oblique incidence C-W transmissions were made during Operation TUMBLER-SNAPPER for the purpose of investigating the effect of an atomic explosion upon the ionosphere and upon radio propagation. The observed effects were attributed to the local changes of ion density caused by the blast wave passing through the existing ionized layers. Disturbance to radio propagation was found to exist for only a few minutes, and would have been troublesome to voice communication only. It was found that the observed phenomena may serve as a means of long-range detection of atomic explosions under certain conditions. The value of large explosions as a tool in ionospheric research was also established. (auth)

2667 (WT-560) HASTY TYPE AIR RAID SHELTERS. Albert E. Murdock (Armed Forces Special Weapons Project. Field Command, Albuquerque, N. Mex.). Feb. 1953. OPERATION TUMBLER. 26p.

Trench shelters capable of being constructed rapidly with ordinary ditching machinery were tested to determine the relative protection afforded by such a shelter when covered with earth spoil and when uncovered. Shelters were placed at various distances from ground zero and instrumented by the use of clothed dummies and film badges to observe the effects of blast and thermal radiation and to measure the value of nuclear radiation. The results show that a covering over a personnel shelter of this type greatly increases its protective potential against nuclear radiation. At 2725 ft from ground zero the dosage of gamma radiation was reduced from 600 to 800 roentgens, for the uncovered shelter, to 160 to 175 roentgens for the covered shelter. It was also determined that these shelters afforded protection from blast and possibly from thermal effects in regions where the nuclear radiation levels were too high to expect any great probability of survival of personnel. (auth)

2668 (FTD-TT-61-396) STRIKING EFFECT OF NUCLEAR EXPLOSION. A. I. Ivanov and G. I. Rybkin. Translation of "Porazhayushchee Deistvie Yadernogo Vzryva" (a publication of the Military Publishing House of the Ministry of Defense, Moscow, 1960). 359p.

Nuclear weapons, their working principles, and combat characteristics are considered. Topics covered include: working principles of nuclear weapons, shock waves from nuclear explosions, luminous radiation from a nuclear explosion, properties of nuclear radiation, penetrating radiation from a nuclear explosion, radioactive contamination during a nuclear explosion, and anti-atomic defense for troops. (M.C.G.)

2669 MODERN RADIOISOTOPE TECHNIQUES. Duane N. Sunderman and Robert A. Ewing. Battelle Tech. Rev., 11: No. 1, 3-8(Jan. 1962).

The use of radioisotopes as tracers and as sources of electromagnetic radiation and energetic nuclear particles is discussed. New developments useful in reaching research objectives and in solving production problems are presented. The basic principles underlying the advances are explained and representative examples of their application are given. (P.C.H.)

2670 ARE SATELLITES NEEDED TO DETECT SECRET NUCLEAR TESTS IN SPACE? Wesley Perry (McGraw-Hill News, Detroit). Electronics, 35: No. 44, 28-30(Nov. 2, 1962).

Techniques for detecting nuclear tests in space and underground were discussed at the International Symposium on Space Phenomena and Measurement. Possible detector equipment for satellites is described briefly. Inspection techniques being developed for suspicious seismic events, including aerial reconnaissance and seismic event analysis, are discussed. (D.L.C.)

2671 SECOND CONFERENCE ON STABLE ISOTOPES, LEIPZIG, OCTOBER 30–NOVEMBER 4, 1961. Kernenergie, 5: 1-442(Apr.-May 1962). (In German)

Sixty-one papers and eleven summaries of papers are included. Separate abstracts have been prepared for each paper. (J.S.R.)

2672 OBTENTION, APPLICATION, AND ANALYSIS OF STABLE ISOTOPES IN THE GERMAN DEMOCRATIC REPUBLIC. J. Muehlenpfordt (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 208-11(Apr.-May 1962). (In German)

A brief survey of the production, utilization, and analysis of stable isotopes in the German Democratic Republic is given as an introduction to the papers presented at the Second Conference on Stable Isotopes, held in Leipzig on Oct. 30 to Nov. 4, 1961. (J.S.R.)

2673 DEVELOPMENT DIRECTIONS IN THE PERFECTION OF METHODS FOR THE SEPARATION OF STABLE ISOTOPES. N. M. Žavoronkov and K. I. Sakodynskij (Karpov Inst. of Physics and Chemistry, Moscow). Kernenergie, 5: 211-19(Apr.-May 1962). (In German)

A survey of the most important developments of the last year in the area of stable isotope separation is given. Exchange distillation of complex compounds and azeotropic mixtures, the simultaneous enrichment of stable isotopes of several elements in one operation, low temperature distillation, centrifuge and separation nozzle methods, thermodiffusion in the liquid phase, the utilization of columns of tube bundles, and the calculation of optimum operation conditions for isotopic separation installations with the help of electronic computers were research projects emphasized for possible future study. (tr-auth)

2674 KINETICS FOR THE ENRICHMENT OF STABLE ISOTOPES IN COLUMNS. S. I. Babkov, N. M. Žavoronkov, G. N. Černych, and L. V. Strel'cov (Karpov Inst. of Physics and Chemistry, Moscow). Kernenergie, 5: 219-23(Apr.-May 1962). (In German)

A mathematical treatment of the kinetics of multiplicative separation processes, which is also valid for higher relative frequencies of the enriching components, is given. The treatment is based on the assumption that the distance from the stationary state is the same at all stages of the separation installation. That this assumption is permitted is shown by the good agreement between theory and experiment. (tr-auth)

2675 THE TIME-DEPENDENT BEHAVIOR OF DISTILLATION COLUMNS. W. Grimm (Institut fur Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 224-8(Apr.-May 1962). (In German)

The time-dependent differential equations for the concentration variation in the distillation of a binary mixture without azeotropic point were formulated for a tube bundle system. The tube bundle system could therefore replace equivalently a packed column. Under the hypothesis of certain assumptions and approximations, the solution was found by means of the Laplace transformation. Two cases were considered—constant initial concentration and the initial concentration modulated in the form of a rectangular pulse. The results of the first case show for the stationary state that the assumption of a straight line amplification equation cannot be maintained on the basis of the consideration of back diffusion. (tr-auth)

2676 THE THEORY OF THE NON-STATIONARY BEHAVIOR OF DISTILLATION COLUMNS. G. Voigt and O. Gebhardt (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 229-36(Apr.-May 1962). (In German)

In order to be able to control distillation columns in an optimum manner, it is necessary to investigate the behavior of the distillation column at control intervals. The behavior of a 5- and a 30-stage distillation column was investigated for imposed fluctuations of the initial concentrations. (tr-auth)

2677 ELECTRICAL MODELS FOR THE INVESTIGATION OF CONCENTRATION FLUCTUATIONS IN DISTILLATION COLUMNS. G. Voigt and K. Koeppen (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 236-41(Apr.-May 1962). (In German)

In order to establish rapidly the behavior of distillation columns in periodic or statistical fluctuations of the operation parameters, a distillation column was represented by electrical networks. In the present stage of development a model was constructed which permits the effect of sinusoidal and rectangular fluctuations of the initial concentration to be studied as a function of the separation stage number, the fluctuation frequency, and the separation factor. The construction and operation of the model was indicated. (tr-auth)

2678 INTERFACE BEHAVIOR OF PACKING MATERIALS FOR ISOTOPE SEPARATION BY DISTILLATION. E. Krell (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 242-5(Apr.-May 1962). (In German)

As a factor in the separation of stable isotopes, the interface behavior of solid/liquid systems was investigated. The effects of the mean roughness depth R_m, metal oxidation, and high polymer source value on the utilization and therefore on the distillation efficiency of packing materials were studied in detail. A series of new data was obtained which leads to a significant increase of the utility of the surfaces of packing materials. (tr-auth)

2679 PRELIMINARY RESULTS OF STUDIES ON "POLPACK" PACKINGS. A. Selecki and B. Tymiński (Univ. of Warsaw). Kernenergie, 5: 246-51(Apr.-May 1962). (In German)

Wire mesh strips bent in a helix were described as a new type of "polpack" column packing. The strips were introduced parallel to each other and parallel to the column axis or in a helix around the axis. The coefficient values found show that these packings have a good separation efficiency and are principally suitable for vacuum distillation. (tr-auth)

2680 INVESTIGATION ON THE SEPARATION OF LITHIUM ISOTOPES BY MOLECULAR DISTILLATION. V. A. Maljusov, N. A. Malafeev, V. J. Orlov, N. N. Umnik, and N. M. Žavoronkov (Karpov Inst. of Physics and Chemistry, Moscow). Kernenergie, 5: 251-6(Apr.-May 1962). (In German)

In a vacuum apparatus with one theoretical plate, the element separation factor α_M of the Li^6/Li^7 system was experimentally determined under non-equilibrium conditions to be 1.09. On the basis of this favorable value, an eight-stage molecular distillation apparatus inclined 1 to 3.5° was constructed from stainless steel. The operational parameters were determined in high vacuum with a test mixture. (tr-auth)

2681 THE SEPARATION OF HYDROGEN ISOTOPES BY DISTILLATION OF AZEOTROPIC MIXTURES OF STRONG ACIDS WITH WATER. IV. EFFECT OF THE INTERMOLECULAR INTERACTION BETWEEN HNO_3 AND H_2O ON THE ELEMENTARY SEPARATION FACTOR IN THE HNO_3/H_2O AZEOTROPE. K. Wetzel (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 256-8(Apr.-May 1962). (In German)

Chemical exchange equilibria are decisive for the distribution of hydrogen isotopes between liquid and vapor of azeotropic acid/water mixtures. The dissociation of the nitric acid calculated from the experimentally-determined elementary separation factor for hydrogen isotopes by distillation of the azeotropic nitric acid/water mixture was compared with the value determined from Raman spectroscopic studies. (tr-auth)

2682 COMPARISON OF DIFFERENT METHODS FOR THE DETERMINATION OF THE ELEMENTARY SEPARATION FACTOR FOR THE CASE OF A SEPARATION OF HYDROGEN ISOTOPES BY EXCHANGE DISTILLATION. G. Kretzschmann, K. Wetzel, H. Schuetze, K. Muehle, and M. Habedank (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 258-61(Apr.-May 1962). (In German)

A series of methods by which the elementary separation factor for hydrogen isotope separation by distillation of an azeotropic nitric acid/water mixture could be determined was considered. In such mixtures there is no simple relation between the separation factor and the vapor pressures of the pure isotopic liquids. The effect of measurement errors in the isotopic analysis on the accuracy of the elementary separation factor determined by Rayleigh evaporation and by column distillation was approximately given. (tr-auth)

2683 LOW TEMPERATURE EXCHANGE DISTILLATION OF DIMETHYLETHER CHLOROHYDRATE. E. F. Cuker and S. V. Ribnikar (Institut für Kernwissenschaften Boris Kidric, Belgrade). Kernenergie, 5: 261-3(Apr.-May 1962). (In German)

Dimethyl ether forms with hydrochloric acid an addition compound which distills at its boiling point of 0.6°C as $(CH_3)_2 \cdot 0.86$ HCl. Under these conditions, the vapor is dissociated approximately 75% so that the so-called exchange distillation can be accomplished. The deuterium was enriched with an elementary separation factor of 1.051, which has a positive temperature coefficient. The heavy oxygen isotope O^{18} was enriched with an elementary separation factor of 1.006 in the liquid phase. (tr-auth)

2684 SEPARATION OF BORON ISOTOPES BY CHEMICAL EXCHANGE. G. M. Pančenkov, A. V. Makarov, and L. I. Pečalin (Moscow State Univ.). Kernenergie, 5: 264-7 (Apr.-May 1962). (In German)

A survey of work done on the development of new methods for the separation of boron isotopes is given. The methods are based on the isotopic exchange reaction between boron trifluoride and its liquid complex compounds with thermal phase reversal. Some properties of the exchange systems used (solubility, desorption kinetics, and isotope exchange kinetics) and the operation of the packed column for $B^{10}F_3$ and $B^{11}F_3$ enrichment were investigated. (tr-auth)

2685 PHASE REVERSAL IN A COLUMN FOR THE SEPARATION OF BORON ISOTOPES BY CHEMICAL EXCHANGE IN THE ANISOLE · BF_3/BF_3 SYSTEM. P. Kulicke, G. Kretzschmann, and G. Schmidt (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 267-9(Apr.-May 1962). (In German)

In the separation of boron isotopes by chemical exchange in the anisole · BF_3/BF_3 system, the BF_3 must be completely removed from the anisole in the phase reversal. By countercurrent distillation in a column, a separation of anisole/BF_3 mixtures is possible. The effect of the reflux ratios on the BF_3 concentration in the intermediate distillation column and evaporator was reported. The BF_3 concentration in the anisole was determined by alkalimetric titration of boric acid after hydrolysis of the BF_3 with $CeCl_3$ solution. (tr-auth)

2686 ENRICHMENT OF THE STABLE ISOTOPE N^{15} BY CHEMICAL EXCHANGE IN THE NO–HNO_3 SYSTEM. E. Krell, H. Schmidt, and S. Thiel (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 269-73 (Apr.-May 1962). (In German)

The procedural engineering measurements were related to the dependence of the HETP value or of the total separation factor ϕ on the column diameter, the specific charge, the exchange temperature, and the reaction water supply. Boundary phenomena in the HNO_3/V2A steel system were investigated in order to determine the optimum formation of the packing material surface. (tr-auth)

2687 SEPARATION OF OXYGEN ISOTOPES WITH THE HELP OF COMPLEX ORGANIC COMPOUNDS OF COBALT. G. M. Pančenkov and A. M. Tolmačev (Moscow State Univ.). Kernenergie, 5: 273-8(Apr.-May 1962). (In German)

The elementary separation factor for the isotopic oxygen molecule was determined in the absorption of oxygen by bis-(N,N′-disalicylalethylenediamine)-μ-aquo-dicobaltate(II) and bis-(N,N′-di-(3-nitrosalicylal)-ethylenediamine)-μ-aquo-dicobaltate(II). For the first complex $\alpha = 1.03 \pm 0.004$ and is practically independent of temperature, and for the second complex $\alpha = 1.02 \pm 0.004$. The kinetics of the reaction of oxygen with the complexes cited were investigated for a large temperature interval. It was shown that the reaction velocity is dependent on the temperature in a complicated manner and is determined by the diffusion velocity of oxygen into the crystalline particles of the complexes. A reaction scheme with which the regularity observed can be explained was presented. The kinetics of the isotope exchange between gaseous oxygen and the oxygen absorbed at various temperatures by the complexes were also studied. The results were clarified with a reaction mechanism scheme. (tr-auth)

2688 QUANTITATIVE ENRICHMENT OF C^{14} IN A THERMAL DIFFUSION COLUMN FOR IMPROVEMENT OF

THE AGE DETERMINATION. G. Dickel (Universität, Munich). Kernenergie, 5: 278-80(Apr.-May 1962). (In German)

It was shown that age determination by the C^{14} method rapidly loses reliability at sample ages over 20,000 years. A significant improvement can, however, be obtained if the sample is subjected to a preliminary quantitative enrichment. With the thermal diffusion column such enrichments can be carried out with great accuracy by using the "transport method" in which the enrichment is strongly time proportional. (tr-auth)

2689 EFFECT OF A THIRD COMPONENT ON THERMAL DIFFUSION IN BINARY ISOTOPIC MIXTURES. F. van der Valk and A. E. de Vries (FOM Laboratorium voor Massascheiding, Amsterdam). Kernenergie, 5: 280-4(Apr.-May 1962). (In German)

A new formula, based on the Chapman-Enskog theory, was given for the thermal diffusion factor $\alpha_{ij}^{(term)}$ for two components of any ternary mixture. By this formula, the effect of Ne^{20} on the separation of $He^3 - He^4$ and the effect of He^4 on the separation of $Ne^{20} - Ne^{22}$ were calculated. Experimental study with the $He^3 - He^4 - Ne^{20} - (Ne^{21}) - Ne^{22}$ mixture was carried out with a 9-stage column. The theoretical assumptions were qualitatively verified. The new formula replaces for any ternary mixture old formulas which depend on the elementary theory. Additional research results with $C^{14}O - C^{12}O$ mixtures, which contained C_2H_4 or $C_2H_2D_2$ as the third component, were given. (tr-auth)

2690 CONTRIBUTION TO THE THERMAL DIFFUSION OF MOLECULES WITH EQUAL MOLECULAR WEIGHT: $C^{12}O^{16}/N^{14}N^{15}$. G. Mueller (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 284-7(Apr.-May 1962). (In German)

In a Clusius-Dickel 2.60-m thermal diffusion column calibrated with natural nitrogen on the basis of the enrichment of $N^{14}N^{15}$, the thermal diffusion factor α for the mixture CO/N_2 was determined to be about 1.4 to 1.8×10^{-3}. In the entire concentration range, the larger N_2 molecule moves toward the cold side. A sign reversal is also not shown in the Chapman-Cowling first approximation calculation. It was found that the isotopic separation factor of one component in the mixture increases with increasing fractions of the other component. (tr-auth)

2691 DETERMINATION OF THE QUANTUM MECHANICAL EFFECT IN THERMAL DIFFUSION AT LOW TEMPERATURES. A. I. Ghozlan and J. Kistemaker (FOM-Laboratorium voor Massascheiding, Amsterdam). Kernenergie, 5: 287-94(Apr.-May 1962). (In German)

An attempt was made to estimate the magnitude of the quantum effect which occurs in thermal diffusion at low temperatures. It was proved that these estimated values are 2 to 3 times larger than the classical values calculated using the Lennard-Jones model. For the experimental verification of these estimated values, the binary mixtures $Kr^{85} - H_2$, $Kr^{85} - Ne^{22}$, $Kr^{85} - He^4$, and $Kr^{85} - He^3$ were investigated. These mixtures contain the radioactive nuclide Kr^{85}, whose β radiation has the energy 0.78 Mev, only in traces which produces after saturation of the walls of the cold reservoir a radiation of about 10^{-9} C/cm^3. The results move in the order of magnitude of the estimated values. There were no useful theoretical calculations for testing the results. (tr-auth)

2692 THE SEPARATION OF CALCIUM ISOTOPES BY COUNTERCURRENT ELECTROMIGRATION IN MOLTEN SALTS. F. Menes, G. Dirian, and E. Roth (Centre d'Etudes Nucléaires, Saclay, France). Kernenergie, 5: 295-300 (Apr.-May 1962). (In German)

The radioisotope Ca^{47} is frequently used for labeling medicine and in biology. It is usually prepared by a (n,γ) reaction on Ca^{46}. For a pure production of Ca^{47}, a preliminary enrichment of Ca^{46}, whose relative frequency in natural Ca is only 3×10^{-5}, is necessary. It was shown that even when an electromagnetic final enrichment is necessary, a preliminary enrichment by the factor of 2 to 10 by physical chemical methods was very desirable. In this way a long, difficult, and costly second separation in the calutron was avoided. The selection of the method was discussed: electromigration in molten salts and the essential physical chemical characteristics of the separation of the calcium by countercurrent electrolysis in molten calcium bromide. The apparatus used was described. The conditions necessary for the preparation of Ca^{47} in significant amounts were derived from the results obtained. (tr-auth)

2693 THE SEPARATION OF OXYGEN ISOTOPES IN THE ELECTROSYNTHESIS OF OZONE. I. A. Semiochin, G. M. Pančekov, and V. K. Korovkin (Moscow State Univ.). Kernenergie, 5: 300-3(Apr.-May 1962). (In German)

By using the electrosynthesis of ozone as an example, it was shown that the modification of the isotopic composition in electogas reactions proceeds with a large isotope effect (order of magnitude of 10‰) in fractions of a second. A mechanism for the separation of oxygen isotopes in ozone electrosynthesis was proposed. (tr-auth)

2694 FRACTIONATION OF LITHIUM ISOTOPES BY CHEMICAL METHODS. A. E. de Vries, F. van der Valk, and A. J. H. Boerboom (FOM Laboratorium voor Massascheiding, Amsterdam). Kernenergie, 5: 304-5(Apr.-May 1962). (In German)

The fractionation of Li isotopes in the precipitation of LiF from aqueous LiCl solutions was measured at various temperatures and concentrations. The magnitude of the separation effect between the solution and an infinitely small amount of precipitate is linearly dependent on the concentration within the limits of the measurement error. The effect of hydration on the isotopic effect of the alkali ions in the ion exchange and on the precipitation was discussed. The isotopic analysis was carried out with a 180° mass spectrometer by surface ionization of LiCl. (tr-auth)

2695 CONSTRUCTION AND PROPERTIES OF THE DRESDEN MAGNETIC ISOTOPE SEPARATOR. M. von Ardenne (Forschungsinstitut Manfred von Ardenne, Dresden). Kernenergie, 5: 305-7(Apr.-May 1962). (In German)

After a review of the principal data on existing magnetic isotope separators, the Dresden magnetic separator was described with respect to the radiation processes, construction, and operation. By suitable curvature of plasma columns and optics of the ion source, a beam cross-over of the ion surface was caused in the 60° separation magnets; the volume of the magnetic field was therefore reduced and the weight of the magnets with respect to large installations with similar mass transport was reduced from 200 to 20 tons. By strongly reducing the oil vapor partial pressure in the radiation space, it was possible to strongly reduce the expenditure for evacuation. After a brief description of the ion source and the pressure ratios in the installation, the results of a separation study with Mg were reported. Its analysis shows an enrichment comparable with other large apparatus. (tr-auth)

2696 ASPECTS AND LIMITS OF ELECTROMAGNETIC SEPARATION FOR THE PRODUCTION OF VERY HIGHLY ENRICHED ISOTOPES. J. Camplan, M. van Ments, and R. Bernas (Faculté des Sciences, Orsay, France). Kernenergie, 5: 308-12(Apr.-May 1962). (In German)

The investigation of the basic causes for the occurrence of contamination and means for correcting their effect was joined to a review of the outputs of various existing electromagnetic isotope separators. The properties of sensitive devices for obtaining the highest enrichment coefficient possible are described in conclusion. (tr-auth)

2697 THREE YEARS OF OPERATION EXPERIENCE WITH THE ELECTROMAGNETIC ISOTOPE SEPARATOR OF THE ZEUTHEN NUCLEAR PHYSICS INSTITUTE OF THE GERMAN ACADEMY OF SCIENCES IN BERLIN. G. Huhn (Kernphysikalisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Kernenergie, 5: 312-16 (Apr.-May 1962). (In German)

The isotopes of Ag, Zn, Mg, Cd, and Fe have been separated at the Zeuthen electromagnetic separator since operation began three years ago. After a brief explanation of the construction of the separator, experiments on beam focusing and space-charge phenomena were described. Experience in the separation of isotopes of individual elements was reported. (tr-auth)

2698 FREQUENCY DISPLACEMENTS AND PARTIAL FUNCTION RATIOS FOR ISOTOPIC MOLECULES IN DEPENDENCE ON THE FORCE CONSTANTS. D. Koch and G. Vojta (Karl-Marx Universitat, Leipzig and Arbeitsstelle für Statistische Physik, der Deutschen Akademie der Wissenschaften, Leipzig). Kernenergie, 5: 317-21(Apr.-May 1962). (In German)

The displacements of the oscillation frequencies for SO_4^{2-} and SO_3^{2-} with substitutions of S^{34}, S^{36}, and O^{18} were shown in dependence on possible compositions of force constants, calculated by the Wilson FG matrix method. By application of approximate potential expressions (Urey-Bradley potential in SO_4^{2-}) and by comparison with similar molecules, closely limited intervals for the general possible values of the force constants and also for the frequency displacements were given. Partial function ratios for various pairs of isotopic molecules were calculated for temperatures of 273.15 up to 400°K. From these results the thermodynamic state functions and the isotopic exchange equilibrium constants were given. (tr-auth)

2699 THE THEORY OF THE ISOTOPE EFFECT FOR DELAYED ROTATORS IN CRYSTAL LATTICES. R. Haberlandt and G. Vojta (Arbeitsstelle für Statistische Physik, der Deutschen Akademie der Wissenschaften, Leipzig and Berlin). Kernenergie, 5: 321-3(Apr.-May 1962). (In German)

The contribution of the delayed rotation of the molecule in the N_2 and CO crystals to the isotope effect was investigated. The necessary formulas for the thermodynamic functions, which are also valid for delayed rotation within the molecule, were derived by application of the Wigner series development for the partial function up to terms with $\hbar^6$. The temperature dependence of the impedance function was calculated by introducing correction functions. From the relation derived in closed form for the thermodynamic functions, numerical values were obtained for the isotope effects in the substitutions $N^{14} \rightarrow N^{15}$ and $C^{12} \rightarrow C^{13}$. (tr-auth)

2700 PHYSICAL CHEMICAL CONSTANTS OF H_2O^{18}. O. V. Uvarov, N. M. Sokolov, and N. M. Žavoronkov (Karpov Inst. of Physics and Chemistry, Moscow). Kernenergie, 5: 323-9(Apr.-May 1962). (In German)

The elementary separation factor α for the $H_2O^{16}-H_2O^{18}$ system was determined in the temperature range from 20 to 210°C by the differential method, and an equation for the temperature dependence of α was given, according to which $\alpha = 1.0038$ for 100°C. From the α values the difference of the heats of evaporation (14.97 cal/mol), the vapor pressure of H_2O^{18} for 20 to 210°C, and the boiling temperature of H_2O^{18} at 760 Torr (100.13°C) were calculated. The difference of the refractive indices $\underline{n}_{H_2O^{18}} - \underline{n}_{H_2O^{16}}$ was determined in dependence on the H_2O^{18} concentration in water at 20°C. With the help of these calculations, $\Delta\underline{n}$ for 100% H_2O^{18} at 20°C was calculated ($\Delta\underline{n} = 3.4 \times 10^{-4}$). The temperature coefficient of the refractive index in the range between 10 and 30°C was determined as $-(1.18 \text{ to } 1.20) \times 10^{-6}$. The density of H_2O^{18} was determined in dependence on concentration at 25 and 30°C, from which the density of 100% H_2O^{18} at these temperatures was calculated. The temperature dependence of the density of water with various H_2O^{18} concentration was determined in the temperature range from 25 to 40°C. (tr-auth)

2701 VAPOR PRESSURE ISOTOPE EFFECTS OF SOME HYDROGEN AND BORON COMPOUNDS. I. Kiss, L. Matus, and I. Opauszky (Zentralforschungsinstitut für Physik, Budapest). Kernenergie, 5: 329-31(Apr.-May 1962). (In German)

Definite relations exist between the vapor pressure isotope effect and the molecular structure. The vapor pressure isotope effect in a series of boron compounds of the type BX_3 is proportional to the reciprocal mass of the ligands X. The temperature coefficients of the vapor pressure isotope effect for BCl_3 and $B(OCH_3)_3$ agree within the limits of the measurement error. The vapor pressure isotope effect of hydrogen in solid water increases regularly with decreasing temperature. The vapor pressure variation was measured with the help of a differential membrane manometer or of a differential liquid manometer. (tr-auth)

2702 THE ISOTOPE EFFECT OF CARBON IN THE CARBON DISULFIDE/XANTHOGENATE SYSTEM. G. Stiehl, R. Kiessling, G. Kretzschmann, and K. Wetzel (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 332-5(Apr.-May 1962). (In German)

The elementary separation factor for the exchange of the carbon isotope in the potassium ethyl xanthogenate/disulfide or potassium methyl xanthogenate/disulfide systems was ≈1.04. Special research made possible a distinction of this thermodynamic isotope effect from the kinetic isotope effect in the decomposition of aqueous xanthogenate solutions with acids. The determination of the isotope exchange velocity in various buffer solutions and the probable exchange mechanism were reported with the help of $C^{13}S_2$. (tr-auth)

2703 THE MECHANISM OF THE ACID AND BASIC CATALYZED DEUTERIUM EXCHANGE IN AROMATIC COMPOUNDS. A. I. Schatenstein (Karpov Inst. of Physics and Chemistry, Moscow). Kernenergie, 5: 335-43(Apr.-May 1962). (In German)

The reaction mechanism of hydrogen isotope exchange in aromatic compounds was compared with irreversible reactions of hydrogen substitution. The acid-catalyzed deuterium exchange proceeds by the mechanism of electrophilic hydrogen substitution (halogenation, nitration, alkylation), whereas the basic catalyzed deuterium exchange in its mechanism displays many points in common with metallation reactions with alkali organic compounds (protophilic hydrogen substitution). In an electrophilic substitution, the reagent is in interaction with the carbon atom or with the entire π electron system of the aromatic rings, and an essential roll is played by the conjugation effect of the substituted and benzyl ring electrons. On the basis of the mechanism of the protophilic hydrogen substitution new experimental material on deuterium exchange, catalyzed by potassium amide solution in liquid ammonia, is mentioned. It was shown that the velocities of these reactions are de-

termined by the acidity and establishment of CH bonds in the transition state. The acidity of the CH bonds of benzyl derivatives can be largely determined by the induction effect of the substitutes. The direct proportionality existing between the partial velocity factors of deuterium exchange in the ortho site and the Taft inductive parameters σ_I is therefore generated. In dependence on the reagent and the reaction mechanism the properties of the electron donors or acceptors bound with each other are dominant in one and the same substitutes (OCH_3, OC_6H_5, $N(CH_3)_2$, and $N(CH_3)C_6H_5$). The alkyl group is an electron donor in deuterium exchange both in acid and in base, but a successive methylation alters the reaction velocity in the opposite direction according to the difference in the reaction mechanisms of the acid and basic catalyzed deuterium exchange. The values measured for the velocity constants lie in the vicinity of the values calculated on the basis of the addition principle according to the partial velocity factors for toluene. (tr-auth)

2704 THE KINETIC ISOTOPE EFFECT OF HYDROGEN IN THE INVESTIGATION OF THE MECHANISM OF SOME ORGANIC REACTIONS. A. F. Rekaševa (Inst. of Physics and Chemistry, Kiev). Kernenergie, 5: 343-7 (Apr.-May 1962). (In German)

By deuterium labeling it was established that for a series of coupled organic redox reactions which later receive the notation hydride migration reactions, no kinetic isotope effects (K_H/K_D = 1.4 to 2.0) are identified. In reactions with inorganic oxidation media, as the Etard reaction, the isotope effect has the magnitude (K_H/K_D = 3.0 to 10.0) to be expected from values given in the literature. These values were considered with respect to the probable path of both reaction types. The first type proceeds by cyclic transition complexes, in which the hydrogen migrates from one carbon atom to the other, whereas in the second type transition complexes of other structures are probable. In studies on the acetylation and hydration mechanisms of acetyls by the Kucerov reaction, normal isotope effects were found. This indicates clearly a bimolecular character of the velocity determining stage of this reaction. The application of the kinetic isotope effect to the investigation of polymerization processes was considered using as an example ethylene polymerization in the presence of Ziegler catalysts. (tr-auth)

2705 KINETIC MEASUREMENT OF THE ISOTOPE EXCHANGE REACTION OF NITROGEN BETWEEN UREA AND AMMONIUM NITRATE. R. Schaedel and H. Huebner (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 347-51(Apr.-May 1962). (In German)

Results of kinetic measurements of the isotope exchange of nitrogen, made on the urea–ammonium nitrate system, are reported. Ideas on the mechanism of isotope exchange reactions were discussed on the basis of the kinetic data. (tr-auth)

2706 THE KINETIC ISOTOPE EFFECT OF THE CARBON ATOM C^{14} IN THE DECARBOXYLATION OF PICOLINE ACID IN THE MOLTEN STATE AND IN SOLUTION. M. Zieliński (Univ. of Warsaw). Kernenergie, 5: 351-5(Apr.-May 1962). (In German)

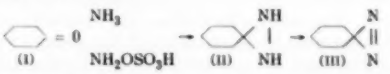
The kinetic isotope effect of the carbon atom (C^{12}/C^{14}) in the decomposition of picoline acid labeled in the carboxyl group in the molten state, in quinoline, and in weakly acid solutions of the phenol type was investigated in the temperature range from 155 to 200°C. The experimental data were compared with the theoretically obtained values. (tr-auth)

2707 KINETIC INVESTIGATIONS ON REDOX REACTIONS WITH HELP OF O^{18}-LABELED BOILING SULFURIC ACID. E. Schulek, I. Pais, and I. Cornides (Eötvös Lóránd Univ., Budapest). Kernenergie, 5: 355-7(Apr.-May 1962). (In German)

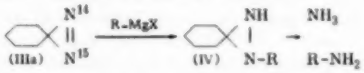
Investigations on the variation of the oxidation number were carried out in boiling sulfuric acid. Therefore both reduction and oxidation reactions occur. In order to clarify the kinetics of these reactions, O^{18}-labeled sulfuric acid was used. The first labeling study was carried out with bichromate, permanganate, and peroxydisulfate ions. For the necessary chemical analysis and isotopic analysis, a conventional analytical mass spectrometer was used. The methodic viewpoints and some results are reported. (tr-auth)

2708 EVIDENCE OF THE STRUCTURE OF CYCLIC DIAZO COMPOUNDS. E. Schmitz and R. Ohme (Institut fur Organische Chemie der Deutschen Akademie der Wissenschaften, Berlin). Kernenergie, 5: 357-8(Apr.-May 1962). (In German)

The cyclic isomers of aliphatic diazo compounds (diaziridine) can be prepared, for example, (III) from cyclohexanone (I) by way of (II):



The cyclic structure of (III) was detected by labeling with N^{15}. Starting with $N^{15}H_3$, (IIIa) was synthesized with the grouping $N^{14}=N^{15}$. The conversion of (IIIa) with Grignard reagent leads to the diaziridine derivative (IV), which was converted by hydrolysis and hydrating N–N splitting in a mixture of ammonia and primary amine:



The ammonia obtained has half the N^{15} labeling of the initial material. The Grignard compound also finds in (IIIa) two chemically equivalent N atoms, which proves the three-ring structure of the cyclic diazo compounds. The possibility of an exchange between NH_3 and NH_2OSO_3H is excluded. (tr-auth)

2709 COMPETITIVE REACTIONS WITH PARTICIPATION OF TWO AMINO GROUPS. I. INVESTIGATION ON THE MECHANISM OF SOME REACTIONS OF UREA AND OF α-NAPHTHYLAMINE WITH N^{15}. P. Krumbiegel and H. Huebner (Institut fur Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 359-61(Apr.-May 1962). (In German)

In reactions of the general form $R_1-NH_2 + R_2-NH_2 \rightarrow R_1-NH-R_2 + NH_3$, it is not at first clear which of the two amino groups was separated as ammonia. This could be decided by labeling one component with N^{15}. Some examples of this type of competitive reactions, in which the reaction pattern could be explained with N^{15} labeling, were mentioned. (tr-auth)

2710 INVESTIGATION OF THE MECHANISM OF THE OXIDATION OF PYRUVIC ACID, PHENOL, AND SALICYLALDEHYDE BY HYDROGEN PEROXIDE WITH THE HELP OF ISOTOPES. M. M. Aleksankin, N. A. Vysockaja, and A. E. Brodsky (Inst. of Physics and Chemistry, Kiev). Kernenergie, 5: 362-5(Apr.-May 1962). (In German)

Labeling with O^{18} permitted the following results to be obtained: In the reaction of hydrogen peroxide with pyruvic acid, the CO_2 formed originates from the carboxyl group, whereas the carbonyl group from which is formed acetic acid is oxidized to the carboxyl group. This reaction passes through the intermediate stage of an oxyhydroperoxide, its rearrangement to the mixed anhydride of acetic and car-

bonic acids and the hydrolysis of the latter with splitting of the oxygen-carboxyl bond. The oxidation of benzoyl formic acid with hydrogen peroxide follows the same mechanism. In the oxidation of salicylaldehyde and m-methoxysalicylaldehyde with hydrogen peroxide, the second hydroxyl group of pyrocatechin being formed originates from the hydrogen peroxide. The mechanism is analogous to the previous reaction: oxyhydroperoxide formation, its rearrangement, and hydrolysis with splitting of the acid-formyl bond. In the oxidation of phenol with hydrogen peroxide in acetic solution or with Fenton reagent, the pyrocatechin also contains the hydroxyl group of the hydrogen peroxide. In the oxidation of phenol with persulfate, the monsulfuric acid ester formed is hydrolyzed by splitting of the O–S bond. In all hydroxylation reactions studied, the free hydroxyl radicals participate not as hydroxylation media in opposition to widely disseminated opinions. (tr-auth)

2711 INVESTIGATION OF THE CONTRIBUTION OF PHENYL RADICALS TO REACTIONS IN SOLUTION WITH THE HELP OF DEUTERIUM. I. P. Gragerov and M. J. Turkina (Inst. of Physics and Chemistry, Kiev). Kernenergie, 5: 365-71(Apr.-May 1962). (In German)

Reactions with the contribution of free phenyl radicals (as the photolysis of iodobenzene or the decomposition of benzoyl peroxide) lead, when they are carried out in solutions of C_6D_6, $C_6D_6 + C_6H_6$, or $C_6D_{12} + C_6H_{12}$, to the appearance of the benzenes C_6H_5D and C_6H_6 in the solvent. These were used for the study of some reactions with unknown or poorly known mechanisms. It was shown that the photolysis of mercury biphenyl, the oxidation of benzene with chromyl chloride, the reaction of magnesium with iodobenzene, and the reaction of phenyl-diazonium chloride with aqueous solution of caustic soda proceeds by a radical mechanism. On the other hand, the thermal decomposition of phenyl diazonium chloride and phenyl diazonium borofluoride proceeds by the transposition of the phenyl residue in the reaction complex without release of the radical. The reaction of iodobenzene with sodium does not proceed by a radical but by an ion mechanism. Mechanisms for the reactions investigated were proposed based on the isotopic analysis of the reaction products and of the benzene or cyclohexane in which they are carried out. The isotopic benzene molecules C_6H_5D and C_6H_6 are formed in the radical reaction in benzene as a result of the splitting of hydrogen from the α-hydrodiphenyl molecules by the phenyl radicals and not by the benzene molecule. (tr-auth)

2712 THE MECHANISM OF THE ANODIC OZONE FORMATION FROM AQUEOUS SULFATE SOLUTION. A. E. Brodsky and V. A. Lunenok-Burmakina (Inst. of Physics and Chemistry, Kiev). Kernenergie, 5: 371-2(Apr.-May 1962). (In German)

By labeling with O^{18} it was established that the ozone on the platinum anode in the electrolysis of sulfuric acid and sulfate arises from surface oxides, that is, not only from the water, but also from the peroxide compounds used in the electrolytes. The anodic reactions of the ozone formation and the formation of elementary oxygen and of persulfate represent parallel processes independent of each other. (tr-auth)

2713 THE POSSIBILITY FOR THE DETERMINATION OF THE DEGREE OF HOMOGENEITY OF FLUIDIZED BEDS USING AN ISOTOPE EXCHANGE REACTION. A. Selecki (Univ. of Warsaw). Kernenergie, 5: 373-8(Apr.-May 1962). (In German)

By using a catalyzed isotope exchange reaction, the possibility for determining the degree of homogeneity of a fluidized bed was investigated. From the "two-phase model" of the fluidized bed, the degree of homogeneity was calculated in dependence on grain size, gas flow-through velocity, and height of the bed. The results agree qualitatively with the results of other workers. Differences arising can be explained by consideration of the penetrating and pulverizing current in the individual measurement methods. The dependence of the apparent activation energy in the fluidized bed on its homogeneity was discussed. (tr-auth)

2714 PHYSIOLOGICAL ASPECTS OF THE UTILIZATION OF STABLE ISOTOPES. A. Stroka and B. Baranowski (Univ. of Warsaw). Kernenergie, 5: 379-84(Apr.-May 1962). (In German)

A bibliographic review is presented of studies on the physiological effects of stable isotopes. 49 references. (J.S.R.)

2715 INVESTIGATIONS OF THE WATER EXCHANGE OF THE SEA FISH MAGIL SALIENS RISSO USING H_2O^{18}. B. B. Vartapetjan (Academy of Sciences, Moscow). Kernenergie, 5: 384-6(Apr.-May 1962). (In German)

The intensity of water exchange in sea bony fish and in fresh water bony fish was investigated using H_2O^{18}. It was shown that the total body water was completely exchanged after 2 hr both in fresh and ocean waters. From calculations of the velocity of the exchange, it appeared that each minute approximately 10% of the body water is exchanged with H_2O of the surrounding medium, and after 15 min half of the total body water is exchanged. (tr-auth)

2716 INVESTIGATIONS ON THE PATTERN OF INORGANIC AND ORGANIC AMMONIUM SALTS IN RATS USING N^{15}. I. Schuett and A. Kohlstrunk. Kernenergie, 5: 386-91(Apr.-May 1962). (In German)

Research with white rats to which varying amounts of N^{15}-diammonium adipinate and ammonium chloride were given is reported. The N^{15} concentration in the blood fraction and the individual organs was followed up to 5 days after the salt administration. In opposition to research on men it was established that the normal N^{15} concentration in organs decomposed by the Kjeldahl method and in the blood fractions of the rats is approximately under the normal biological N^{15} value of 0.380 at. %. The ammonium nitrogen from the chloride was retained in the rat better than the nitrogen from the ammonium adipinate. The significance which the uptake of the ammonium has for nitrogen metabolism is discussed. (tr-auth)

2717 THE INCORPORATION OF LABELED FERTILIZING NITROGEN IN THE N FRACTIONS OF THE RIPENING WHEAT PLANT. H. Faust (Friedrich-Schiller Universitat, Jena, Ger.). Kernenergie, 5: 391-2(Apr.-May 1962). (In German)

In a vascular study, wheat was fertilized with labeled nitrogen after blooming and harvested after 4 or 10 days. The N^{15} concentrations were determined in individual N-containing compounds of the stalk and the grain. The results showed that the soluble N fraction both in the stalk and in the grain was more strongly labeled than in the albumin. In the albumin, N^{15} was more strongly incorporated in the NH_3 and glutamic acid. The high labeling in the glutamic acid indicates that this substance has important functions in the N metabolism of the ripening wheat plant. (J.S.R.)

2718 INVESTIGATIONS ON THE UPTAKE AND INCORPORATION OF NITROGEN BY THE GERMINAL ROOT OF VICIA FABA USING N^{15}. G. Huebner (Institut für Physikalische Stofftrennung, Leipzig) and K. Ramshorn. Kernenergie, 5: 392-5(Apr.-May 1962). (In German)

A study was made to determine the uptake and incorporation of exogenic inorganic N compounds in seedlings of

Vicia faba using N^{15}. The results show a maximum incorporation in the growing zone. The fraction of exogenic nitrogen in the soluble and albumin nitrogen is significantly higher in NH_4^+ application than in NO_3^- application. The results of the Kjeldahl analyses make it very probable that the mobilization of the material in the cotyledons was modified by the presence of exogenic N sources or that alteration of the reference magnitude "fresh weight" occurred as a result of a salt effect. (tr-auth)

2719 CONTRIBUTION TO THE GEOCHEMISTRY OF LEAD ISOTOPES. A. Kovách (Institut für Atomkernforschung der Ungarischen Akademie der Wissenschaften, Debrecen, Ger.). Kernenergie, 5: 395-8(Apr.-May 1962). (In German)

Mass spectrometric studies on lead galena from Hungarian deposits were reported. The results were discussed from the standpoint of absolute age determination. The measurement points show a linear, but non-isochronous distribution in the Houtermann diagram. The principles of a new model, based on a development of the lead isotopic ratio limited by probability rules, were discussed. (tr-auth)

2720 ISOTOPIC ANALYSIS OF OXYGEN FOR THE DETERMINATION OF GEOLOGICAL TEMPERATURES USING THE MI-1305 MASS SPECTROMETER. I. Opauszky, L. Matus, J. Lukács, and I. Kiss (Central Inst. of Research for Physics, Budapest). Kernenergie, 5: 398-401(Apr.-May 1962). (In German)

The determination of paleotemperatures in connection with archeological studies of a Neanderthal settlement deposited in fresh water lime was reported. With the help of a mass spectrometer rebuilt for this special purpose, the O^{18}/O^{16} ratio of four bore samples from 0.22, 52, and 77 m boring depth was measured, and the relative formation temperatures were placed at −68.0, 35, and 70°C. A reason was given for the strikingly large difference between the formation temperatures. (tr-auth)

2721 DECOMPOSITION OF SULFATES FOR THE ISOTOPIC ANALYSIS OF OXYGEN. I. Maass (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 402-3(Apr.-May 1962). (In German)

The reaction of synthetic sulfates with $Hg(CN)_2$ at increased temperatures leads to the conversion of the sulfate oxygen into CO_2 and thus into a compound which can be used for mass spectrometric isotope analysis. (tr-auth)

2722 A MICROMETHOD FOR THE CONVERSION OF AMMONIUM SALTS TO N_2 USING CuO FOR THE ISOTOPIC ANALYSIS OF NITROGEN. W. Rolle (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 403-4 (Apr.-May 1962). (In German)

A micromethod (≥5 mg NH_4Cl) for the oxidation of ammonium salts to elementary nitrogen using CuO and requiring only slight work expenditure was described. The ammonium salt and the CuO were heated in an ampule outpumped to high vacuum and then sealed, and the gas produced was led to the mass spectrometer. Comparison measurements between this and the classical hypobromite method shows the applicability of the CuO method in the area of natural N^{15} concentration up to high concentrations of more than 90 at. %. (tr-auth)

2723 SOME REMARKS ON THE DETERMINATION OF SULFUR ISOTOPE FREQUENCIES. I. Schrage. Kernenergie, 5: 405(Apr.-May 1962). (In German)

Some experience obtained in the preparation of SO_2 from sulfides is reported. Factors that produce the results are pointed out. (tr-auth)

2724 A QUADRUPOLE MASS FILTER. G. Otto (Karl-Marx Universität, Leipzig). Kernenergie, 5: 406-11 (Apr.-May 1962). (In German)

After some brief theoretical remarks on the behavior of charge carriers in high-frequency quadrupole field, the maximum possible oscillation amplitudes for four parameters of the motion equations were calculated, and the utilization of the quadrupole mass filter for H−D isotope analysis at high deuterium concentrations was described. (tr-auth)

2725 THE FORMATION OF THE H_3^+, H_2D^+, AND D_3^+ IN ELECTRON IMPACT ION SOURCES. F. Bigl (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 411-15(Apr.-May 1962). (In German)

By utilization of simple statistical combination rules, the yields of H_3^+, H_2D^+, HD_2^+, and D_3^+ to be expected in electron impact ion sources in H−D mixtures was calculated in dependence on the deuterium concentration. The curves for HD_2^+ and D_3^+ calculated from measurements with two mass spectrometers of the Nier type are, on an average, only 0.5 to 0.6 times the statistically expected yield. From the difference determined, conclusions on the collision cross section can then be drawn when quantitative expressions on the dissociation of the metastable ions in the analysis apparatus exist. (tr-auth)

2726 MASS SPECTROMETRIC ISOTOPIC ANALYSIS OF BORON BY THE THERMAL EMISSION METHOD. A. M. Kolčin, G. M. Pančenkov, V. F. Malachov, and J. Stejny (Moscow State Univ.). Kernenergie, 5: 416-19 (Apr.-May 1962). (In German)

A method for the isotopic analysis of boron by the thermal emission method was developed. For the analysis oxygen compounds and elementary boron were used. Commercial mass spectrometers without additional electron multipliers could be used. The method is free of "memory" effects. At least 100 μg of borax (or 10 μg boron) are necessary for a reliable analysis; impurities do not affect the results. The isotopic composition of natural boron was measured, and the atomic weight of boron was calculated. It was assumed that the $Na_2BO_2^+$ ions in the thermal emission are formed by surface ionization of the Na_2BO_2 radical. This radical is the product of a redox reaction. (tr-auth)

2727 INTERFERENCE OF H ACCUMULATIONS IN MASS SPECTROMETRIC ISOTOPE ANALYSIS. G. Haase (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 419-21(Apr.-May 1962). (In German)

Hydrogen and hydrogen compounds affect the mass spectrometric isotope analysis of other elements even when its mass lines do not agree with those necessary for isotope analysis. The interfering effect depends on hydrogen accumulations which arise probably by secondary reactions in the ion source. The effect of the accumulation on the isotopic analysis was shown quantitatively for the molecules N_2, CO, and CO_2. (tr-auth)

2728 MASS SPECTROMETRIC ISOTOPE ANALYSIS OF LABELED COMPOUNDS AT LOW ENERGIES OF THE IONIZING ELECTRONS. H. Birkenfeld (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 421-5(Apr.-May 1962). (In German)

Chemical compounds, especially hydrocarbons, have an extensive mass spectrum. In the determination of the relative isotope frequencies, the parent peaks from dissociated molecular ions of the labeled compounds are often superposed. Taking reference spectra is, because of the lack of 100% labeled compounds, possible only in rare cases. With reduction of the energy of the ionizing electrons, the in-

tensity of the parent peak is decreased, but the intensities of the fragment ions decreases more sharply and are so small at 12 to 16 ev that they are less than 1% of the principal line. In the evaluation no consideration of the fragment ions is necessary. These data were tested on various compounds. (tr-auth)

2729 SPECTRAL ANALYSIS OF H_2O-D_2O MIXTURES. G. Jaeger and W. Mikkeleit (Friedrich-Schiller Universität, Jena, Ger.). Kernenergie, 5: 426-33(Apr.-May 1962). (In German)

A determination method for the concentration range 1 to 86.5% D_2O in H_2O was perfected using density measurements on lines of the $^5R_{21}$ branch of the 0,0 transition (3064 Å) of the $A^2\Sigma^+-X^2\pi_i$ electron band system of the OH and OD radicals. A discharge tube specially constructed for the purpose was used for spectrum excitation. The photographs were taken with a quartz spectrograph. The calibration curves $\lg(C_{OH_2}/C_{OD_2})/\lg(I_{OH}/I_{OD})$; $\lg(C_{OH_2}/C_{OD_2})/\Delta S$; $\%D_2O/\Delta S$ were derived. In the average concentration range, the relative error is under ±2%; at small D_2O concentrations (1%) it increases to approximately ±25%. (tr-auth)

2730 THE GAS CHROMATOGRAPHIC SEPARATION OF HYDROGEN ISOTOPES AND THEIR NUCLEAR SPIN ISOMERS. M. Mohnke and W. Saffert (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 434-5 (Apr.-May 1962). (In German)

A study was made to connect gas chromatographic separation of hydrogen isotopes with the new method of adsorption capillary chromatography. A glass capillary was used as the thermal diffusion column. The capillary was provided with an incipient corrosion layer by treatment with aqueous NH_3 solution at 170°C. Neon was used as the carrier gas, and the operating temperature was 77.4°K. A microthermal conductivity cell was the detector. The results obtained show that this new method is completely suitable for isotopic analysis. (tr-auth)

2731 GAS CHROMATOGRAPHIC ISOTOPE ANALYSIS OF DEUTERIUM BY HEAT CONDUCTIVITY MEASUREMENTS IN HYDROGEN CURRENTS. M. Mohnke (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 435-6(Apr.-May 1962). (In German)

A method which makes possible the determination of the relative frequency of deuterium in water or hydrogen samples is described. The water samples are reacted with calcium hydride and the hydrogen is carried into a thermal conductivity cell with a carrier gas containing a known deuterium concentration. The variation in the thermal conductivity is a measurement of the relative deuterium frequency. A sketch of the apparatus and a calibration curve is given. (J.S.R.)

2732 DETERMINATION OF THE RELATIVE ABUNDANCE OF B^{10} BY ACTIVATION ANALYSIS. M. Mohnke (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie, 5: 436-7(Apr.-May 1962). (In German)

The activation determination of the relative abundance of B^{10} was experimentally investigated. The activity of the Mn solution was determined in dependence on the number of Mn^{56} nuclei present. The decay curves of a pure Mn^{56} solution and of a solution to which B^{10} was added before irradiation were measured and shown graphically. A calibration curve of the B^{10} activity as a function of concentration is given. (J.S.R.)

2733 EFFECTS OF A 20-MEGATON THERMONUCLEAR EXPLOSION ON COLUMBUS CIRCLE. Scientists' Committee for Radiation Information, New York Academy of Sciences. N. Y. State J. Med., 62: 268-74(Jan. 15, 1962).

A description is given of what would happen to the New York metropolitan area and its residents if a single, 20-megaton bomb hit Columbus Circle in midtown Manhattan. The casualties could include 5 to 6 million dead out of 8 million New Yorkers within the first few days. In the 17-county New York-New Jersey metropolitan area fatalities and injuries could claim about 9 million out of the population of 13 million. The hole extending from ground zero would cover a 20-block area and be deep enough to hide a 20-story building. It would extend from 55th to 63rd Streets and from east of 7th Avenue to west of Columbus Avenue. The subway systems, which are interconnected in the midtown area, would be penetrated. With a 7.7-mile radius of Columbus Circle, the blast would produce severe structural damage. At the outer edge of this circle, most unreinforced brick or wood-frame houses would be completely demolished; brick apartment buildings would probably still be standing but would need major repairs. However, within a 6.4-mile radius, they too would collapse. An air burst would extend the major damage radius to 10 miles. Within a 15-mile radius, the damage would be less severe but extensive. Up to 40 miles away there would be some damage, such as window breakage, in the majority of structures. In the resulting firestorm, within the radius of 21 miles from Columbus Circle, it is probably conservative to predict an average of 10 ignition points per acre in every part of the city. Since New York City covers about 200,000 acres, this would result in nearly 2 million fires in the city. If it is assumed that the attack came on a day when the winds were west-soutwest with an average velocity of 40 mph, Long Island would be inundated with fallout. A 4,000-square-mile area would contain sufficient radioactivity to deliver a dose of 9,100 r to the unshielded population between the end of the 1st hour and the end of the 2nd day after the detonation. This dose exceeds the lethal dose for 50% of the unshielded population by a factor of 20. (H.H.D.)

2734 STRUCTURE SHIELDING AGAINST FALLOUT RADIATION FROM NUCLEAR WEAPONS. L. V. Spencer (National Bureau of Standards, Washington, D. C.). June 1, 1962. 137p. (NBS-MON-42).

The theory of structure shielding from fallout gamma radiation is developed to the point of applications to elementary structure types. Examples discussed in the text include the density interface, foxhole, shielded foxhole or basement, light superstructure, vertical wall, blockhouse, vents, compartmentalization effects, and mazes. A large number of engineering charts and graphs are presented for engineering calculations, including many obtained from angular distributions of the exposure dose. Results are given for a fission spectrum, and for Co^{60} and Cs^{137} sources. This information has been obtained almost completely by machine calculations utilizing basic cross section data. A number of sources of experimental data are mentioned, but detailed comparisons with experiment are not included. (auth)

2735 PROGRESS IN VERY HIGH PRESSURE RESEARCH. Proceedings of an International Conference held at Bolton Landing, Lake George, New York, on June 13-14, 1960. E. P. Bundy, W. R. Hibbard, Jr., and H. M. Strong, eds. New York, John Wiley and Sons, Inc., 1961. 332p.

A total of 27 papers was presented on equipment and techniques, structures of materials formed under pressure, and behavior of matter under high pressure. Two of the papers are a review of high-pressure work in USSR and a tabulation of conversion factors between pressure units. Separate abstracts were prepared for three of the papers. (D.L.C.)

2736 THE SYNTHESIS OF THE CUBIC FORM OF BORON NITRIDE. R. H. Wentorf, Jr. (General Electric Research Lab., Schenectady, N. Y.). p.82-9 of "Progress in Very High Pressure Research." New York, John Wiley and Sons, Inc., 1961.

A study of the formation of cubic boron nitride shows that the alkali and alkaline earth metals and their nitrides are effective catalysts for converting hexagonal boron nitride into cubic. The pressure and temperature required vary with the catalyst, and a minimum of about 55,000 atmospheres and 1500°C was found to be optimum up to the present time. (auth)

2737 STATE OF MATTER AT HIGH PRESSURE. B. J. Alder (Univ. of California, Livermore). p.152-64 of "Progress in Very High Pressure Research." New York, John Wiley and Sons, Inc., 1961.

The region where exact thermodynamic description of the state of matter at high pressure and high temperature is possible is located. In the remaining region, various approximate theories and empirical relations are discussed. These considerations are applied to hydrogen to locate the density and pressure at which the diatomic bond collapses. Also the approximate conditions are determined at which no bound electron states exist. (auth)

2738 NUCLEAR MAGNETIC RESONANCE IN SOLIDS AND LIQUIDS UNDER PRESSURE. G. B. Benedek (Harvard Univ., Cambridge, Mass.). p.288-9 of "Progress in Very High Pressure Research." New York, John Wiley and Sons, Inc., 1961.

The NMR frequency of F^{19} in antiferromagnetic MnF_2 was measured as a function of pressure at different temperatures. The pressure dependences of the hyperfine coupling constant (A) between Mn and F nuclei and of the Neel temperature were found to be $(1/A)(dA/dP) = 1.9 \pm 0.1 \times 10^{-6}/(kg/cm^2)$ and $(1/T_N)(dT_N/dP) = 4.4 \pm 0.3 \times 10^{-6}/(kg/cm^2)$. The pressure dependence of the chemical shift of the Co^{59} resonance was also measured in aqueous solutions of diamagnetic $K_3Co(CN)_6$, $Na_3Co(NO_2)_6$, and $Co(NH_3)Cl_3$ to 10,000 kg/cm^2. It was found to be $(1/\nu)(d\nu/dP) = -2.18 \times 10^{-6}$, -3.25×10^{-6}, and $-4.59 \times 10^{-6}/(kg/cm^2)$, respectively. The results are interpreted in terms of crystalline field splitting of the cobalt orbitals. (D.L.C.)

2739 LA LIBÉRATION DE L'ÉNERGIE NUCLÉAIRE. (The Utilization of Nuclear Energy). Marc Lefort. Applications des Sciences Nucleaires. Brussels, Compagnie Belge d'Editions, S.P.R.L. and Paris, Gauthier-Villars & Cie, 1961. 119p.

The characteristics of the release and utilization of nuclear energy by fission in various types of reactors and by fusion of light nuclei are described for the layman. Direct transformation into electric energy and the economic and social implications of nuclear energy for the future are also discussed. (J.S.R.)

2740 CONDITIONS FOR THE ESTABLISHMENT AND DEVELOPMENT OF THE EUROPEAN NUCLEAR INDUSTRY, PARIS CONGRESS, 12-14th SEPTEMBER 1962. VOLUME 1, PARTS 1 AND 2. Reports Submitted by the Ten FORATOM Associations. (Forum Atomique Europeen, Paris). 1962. 870p. (In English, French, and German)

A large number of papers are presented on various aspects of nuclear power and radioisotope applications in Europe. (D.L.C.)

2741 PROCEEDINGS OF THE TENTH CONFERENCE ON HOT LABORATORIES AND EQUIPMENT. Held in Conjunction with American Nuclear Society Winter Meeting, Washington, D. C., November 26-28, 1962. (American Nuclear Society, Chicago). 1962. 351p.

Forty-six papers are included; separate abstracts were prepared for 40. Six of the papers were previously abstracted in NSA. These include information on FBR-II fuel dismantling equipment, mechanical decanning of EBR-II fuel elements, mechanical equipment for dejacketing spent SRE Core-1 fuel, improved macro camera for hot cell application, applications of basic alpha instrumentation, and fire and explosion tests of plutonium glove-boxes. A separate author abstract is included. (P.C.H.)

2742 TRANSURANIUM PROCESSING FACILITY DESIGN. W. E. Unger, B. F. Bottenfield, and F. L. Hannon (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 3-10(1962).

The Transuranium Processing Facility will isolate the transuranium elements produced by the irradiation of Pu^{242} and Am^{243}-Cm^{244} in the High Flux Isotope Reactor presently under construction at ORNL. The facility is designed for the production and cumulative storage of up to 4 g of Cf^{252} which will be ultimately employed for research purposes. The facility will consist of nine heavily shielded process cells and eight laboratories. The toxicity of the heavier transuranium elements justifies a refined building containment and ventilation system. The building is scheduled for full-scale operation by December 1965, at an estimated cost of $8.7 million. (auth)

2743 EVALUATION OF SHIELDING AND HAZARDS IN THE TRANSURANIUM PROCESSING FACILITY. J. P. Nichols, E. D. Arnold, and D. K. Trubey (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 11-18(1962).

Shielding and containment criteria for the Transuranium Facility obtained by calculations and experiments are given. The shield evaluation studies (for cell walls, cell windows, and fission source carriers) utilized experiments at the ORNL Lid Tank Shielding Facility and IBM-7090 computer calculations for determination of neutron transport, neutron activation, and gamma penetration. Studies also included an evaluation of the effects of credible accidents occurring in the facility. (auth)

2744 PROCESS EQUIPMENT DESIGN AND DEVELOPMENT FOR TRANSURANIUM PROCESSING FACILITY. O. O. Yarbro, J. L. English, and T. S. Mackey (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 19-26(1962).

Target rods irradiated in the High Flux Isotope Reactor are to be chemically processed for the recovery and decontamination of the various actinide elements produced in the reactor. The processing equipment is to be located in four of the nine cubicles and seven tank pits of the Transuranium Processing Facility cell bank. Activity and contamination levels in the process equipment necessitate the use of remote or semi-remote maintenance techniques. Maintenance and plant modifications are simplified by a remotely operated piping disconnect developed for this purpose. The choice of materials of construction for the process equipment and piping is limited by the hydrochloric acid environment and intense radioactivity of the process solutions. Hastelloy C appears to be acceptable for low temperature service while only tantalum, Zircaloy-2, or glass is suitable for solutions at elevated temperatures. (auth)

2745 DEVELOPMENT OF PROCEDURES AND EQUIPMENT FOR FABRICATION OF THE HIGH-FLUX ISOTOPE REACTOR TARGET RODS. W. C. Thurber and A. L. Lotts (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 27-38 (1962).

The process developed to fabricate target rods for irra-

diation of actinide elements in the High-Flux Isotope Reactor and the equipment to be used in remotely refabricating these targets in the Transuranium Processing Plant are described. Remote fabrication techniques are required since both gamma rays and neutrons (from spontaneous fission) are emitted from the nuclides of interest. (auth)

2746 CONTAMINATION CONTROL IN ARGONNE CHEMISTRY CAVE. C. H. Youngquist, W. C. Mohr, and S. J. Vachta (Argonne National Lab., Ill.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 39-44(1962). (TID-16213)

A new chemistry cave at Argonne was designed for the use of in-cell containment boxes. Inlet air in the boxes will be through a series of three inlet filters taking air from a clean area through progressively more suspect areas and ending in the containment box. Air is exhausted from the box through three high efficiency filters in series, which have an overall decontamination factor of 10^{10}. A transfer tunnel that utilizes the favorable geometry of two intersecting thick shielding walls permits removal of material from the cell directly into a gloved box for the preparation of assay samples. (auth)

2747 A 4-INCH PORTABLE NEUTRON SHIELD FOR A RADIOCHEMISTRY ENCLOSURE. Leonard E. Miles, Patrick W. Howe, and Thomas C. Parsons (Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 45-48(1962).

A simple portable neutron shield enclosure with tong manipulators for surrounding a radiochemistry box-type enclosure is described. The shield allows the chemist to work with safety with neutron emitters having a flux density equivalent to a point source of 5.56×10^6 neutrons/sec. Except for minor adjustments, the radiochemistry enclosure can be completely equipped and quickly slid into the shield enclosure ready for work. (auth)

2748 A SURVEY OF STRUCTURAL MATERIALS FOR USE IN REMOTE HANDLING FACILITIES. H. M. Glen (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 49-52(1962).

Discussion is given on the kinds of structural materials used in remote handling facilities and the manner in which they are specified, which can be significant factors in determining the cost of a facility. The materials and factors include concretes with high water retention for neutron shielding; the placement, quality control, and reinforcing of the concretes; and the use of stainless steel for cell liners. (auth)

2749 NEW HOT LABORATORY FACILITIES AT LOS ALAMOS. Charles R. Wherritt, Paul Franke, R. E. Field, and A. R. Lyle (Los Alamos Scientific Lab., N. Mex.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 55-62(1962). (LADC-5442)

New Hot Laboratory Facilities which support three major research programs directed by the Los Alamos Scientific Laboratory of the University of California are described. For the Nuclear Rocket Propulsion Program, a hot cell addition to the Radio Chemistry Building at Los Alamos will be completed early in 1963, and construction is expected to start soon on the hot cell addition to the Maintenance, Assembly and Disassembly Building at the Nuclear Rocket Development Station in Nevada. Integral hot laboratories are designed in the facilities for the Ultra High Temperature Reactor Experiment and the Fast Reactor Core Test at Los Alamos. (auth)

2750 UNIVERSITY OF MARYLAND GAMMA LABORATORY. Joseph Silverman and C. B. Agnihotri (Univ. of Maryland, College Park). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 63-8(1962).

A gamma irradiation facility was constructed at the University of Maryland. It consists of an underground irradiation chamber, $15 \times 4 \times 7$ ft, connected to the surface by a Z-shaped labyrinth and a stairway. Targets are placed in the chamber and irradiated by 5000 curie Co^{60} source that is lowered from a lead shield located in the ceiling. The concrete substructure is covered by a prefabricated steel panel structure that houses control and drive mechanisms, and laboratory facilities. The entire cost of the installation was $30,000. (auth)

2751 FOUR YEARS OPERATING EXPERIENCE AT THE SACLAY LABORATORY FOR RESEARCH ON IRRADIATED FUELS (LECD). C. E. Brebant and F. L. Mathern (Commissariat à l'Energie Atomique, Fontenay-aux-Roses, France). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 69-82(1962).

Operating experience at the Saclay Laboratory after 4 years is described. The laboratory consists of four machining caves and one storage cave in a line with protection for 10^4 C, and six analysis caves with protection for 100 C. Operating experience with the original equipment in the machining cave indicated the need for complete redesign. The redesign increased the remote repairability and reduced the decontamination and removal time of the equipment. Other changes improved the accuracy and efficiency with which the equipment can be operated. The laboratory building was modified to increase the size of a hot change room and a new cold change room was added. (auth)

2752 SAFETY AND MAINTENANCE CHARACTERISTICS IN A LINE OF CELLS. P. Faugeras (Centre d'Études Nucléaires, Fontenay-aux-Roses, France), J. Couture, H. Guillet, and G. Cherel. Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 83-9(1962).

A line of cells was designed and operated for analysis of samples taken from the Plutonium Pilot Works at Marcoule. The objective was to obtain maximum safety, while preserving rapidity of operation and ease of equipment maintenance. Work is carried out in sealed boxes which are accessible from the back for maintenance through gloves, or the entire box can be removed. The boxes are interconnected with a pneumatic transfer system for samples and a sealed magnetic conveyor system for small equipment and solid wastes. (auth)

2753 MAINTENANCE CELL FOR HALLAM NUCLEAR POWER FACILITY. Elton C. Turner (Atomics International, Canoga Park, Calif.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 111-20(1962).

The design and performance of the Hallam Nuclear Power Facility (HNPF) maintenance cell is given. The maintenance cell is located beneath the reactor room floor near the reactor fuel storage area. The cell provides facilities for the assembly, disassembly, inspection, and maintenance of radioactive reactor core components and the HNPF fuel handling machine internal mechanisms. The maintenance cell is shielded and equipped to maintain a controlled nitrogen or air atmosphere as required by cell operations. Radioactive component access is provided to the cell through ports in the cell roof. Equipment access is provided through a tunnel from the plant decontamination area. The major work load in the cell will be the assembly and disassembly of radioactive fuel elements. (auth)

2754 COBALT-60 IRRADIATORS USED FOR RESEARCH AND FOREIGN EXHIBITS. O. A. Kuhl and A. Oltmann (Brookhaven National Lab., Upton, N. Y.). Proc.

Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 121-4 (1962).

Two pool type gamma irradiation units were designed and constructed. The units are easily installed and removed. A stainless steel tank, filled with water, shields 2000 curies of cobalt-60. A source rack holds the sources in various precalibrated positions. Water-tight canisters are used to contain the materials to be irradiated. The research facility also employs a tank filled with water to shield 30,000 curies of cobalt-60. Three water-tight containers hold material up to 6 × 8 × 14 in. in size and are automatically moved into and out of the radiation field provided by two source plaques. Temperature and atmosphere within the containers can be controlled. (auth)

2755 A SHAPED-PULSE GAMMA IRRADIATOR. Roland G. Struss (Sandia Corp., Albuquerque, N. Mex.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 125-7(1962).

A system designed to produce flux rise times of very short duration and also flux cutoff of very short duration is shown schematically. The shaped gamma pulse is produced by driving a shuttle carrying the source, 1000 curies of cobalt-60, with an air cylinder. This produces a flux increase from zero to maximum in eight milliseconds, and a flux decrease from maximum to zero in twelve milliseconds. Maximum dose rate to test specimens is 5×10^4 r/hr. A sample carrier which can be moved during irradiations can vary the dose rate during an exposure. Thus a square wave or shaped wave of flux versus time can be generated. (auth)

2756 CELL FACILITIES AT COMMERCIAL PRODUCTS DIVISION OF ATOMIC ENERGY OF CANADA, LIMITED. R. G. Waterfall and B. L. J. Ullyett (Atomic Energy of Canada Ltd., Ottawa). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 129-40(1962).

Four cells were built to enable radioactive isotopes to be processed. Work in the cells includes source fabrication, irradiator loading, radiochemical processing, the transfer of isotopes to processes elsewhere in the building, and the preparation for shipment of unprocessed isotopes. (auth)

2757 1500-CURIE Co-60 BIOMEDICAL IRRADIATOR. Phillip A. Bohm, George L. Wigle, and Thomas C. Parsons (Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 141-6(1962).

Description is given of an irradiator designed to produce dose rates ranging from 3 million to 7 r/hr, with infinitely variable dose rates obtainable between the limits by the use of two capsules of Co^{60} source material. The two primary uses of the irradiator are animal irradiation and studies of chemical systems. The irradiator is also a self-supporting shipping container as well as in-place shield head. By the use of an extraction mechanism, either source may safely be entirely removed from the confines of the irradiator in order to obtain extremely high rates of ionization. The weight and dimensions of the assembled irradiator allow it to be easily handled and transported. (auth)

2758 A PROCEDURE FOR CLEANING CLOUDED OIL-FILLED RADIATION SHIELDING WINDOWS. T. E. McGary and J. S. Mazza (Pittsburgh Plate Glass Co., Harmer Township, Penna.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 149-52(1962).

A procedure for the in situ cleaning of clouded, oil filled radiation shielding windows was developed. The procedure, which is a filling and draining technique, was successfully field tested. A severely clouded window was restored nearly to the original state of clarity as judged by visual observation. The technique uses glacial acetic acid to dissolve the cloudy sludge from the window interior. An inert atmosphere within the window must be used during cleaning to prevent component damage. A solvent rinse must precede and follow the acid cleaning to permit cleaning and minimize reclouding. (auth)

2759 A GAS-TIGHT DIRECT-COUPLED MECHANICAL MASTER-SLAVE MANIPULATOR FOR ALPHA-GAMMA FACILITIES. Lester W. Haaker, Robert A. Olsen, and Demetrius G. Jelatis (Central Research Labs., Inc., Red Wing, Minn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 153-6(1962).

A gas-tight, mechanical master-slave manipulator was developed for use in alpha-gamma facilities. It has the same operating characteristics and capacities as the well-known Model 8 Master-Slave Manipulator. The seal system allows its use in cells with exotic atmospheres, giving freedom of manipulation while maintaining the integrity of the cell atmosphere. The manipulator consists of three distinct, easily separable assemblies: a master arm, a slave arm, and a seal tube assembly. The entire master arm remains in the operator's environment, the slave arm in the cell environment, and the seal tube in the shielding wall separates the two environments with a pressurized gas lock. (auth)

2760 A RUGGED-DUTY MAN-CAPACITY MASTER-SLAVE MANIPULATOR. Demetrius G. Jelatis (Central Research Labs., Inc., Red Wing, Minn.), Lester W. Haaker, and Robert A. Olsen. Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 157-66(1962).

A ruggedized version of the well-known model-8 is described. Consideration of performance characteristics casts doubt on the validity of over simplified numerical load ratings, emphasizing instead, classification by functional task description, responsiveness, and effectiveness of operator-to-load coupling. Improved capacity and reliability is achieved by use of stronger materials, reduction of critical contact stresses, introduction of gearing to speed up coupling tapes, and development of a unique gripping concept. Man-capacity characterizes the effective utilization of a human operator's maximum exertion. (auth)

2761 THE BEETLE, A MOBILE SHIELDED CAB WITH MANIPULATORS. Charles L. Hunt (U. S. Air Force, Kirtland AFB, Albuquerque, N. Mex.) and Frank C. Linn. Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 167-84(1962).

A manned, self-propelled, lead shielded, 85-ton vehicle with manipulators, that is designed to operate in radiation environments was constructed. The intended operation and development of the vehicle is described. Notable features include: 12 inches of lead shielding; five two-foot thick leaded windows; 550-horsepower main engine; 110-horsepower auxiliary power package; filtered air conditioning; two high capacity manipulators; emergency and safety systems; communications equipment; 25-foot vertical movement and 360° rotation of the cab. (auth)

2762 NEW TYPES OF HEAVY MANIPULATORS. J. Vertut (Commissariat à l'Energie Atomique, Fontenay-aux-Roses, France). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 185-94(1962).

Four types of manipulator arms of 100, 300, and 1000 kg capacity were developed with different carrier designs for use in general or special purpose hot cells and on a cable controlled vehicle for applications extending over a large area. The manipulators have a low probability of failure, with a capability of being easily repaired remotely. The arm is immersible and easily decontaminated. Emergency

drives, accessible from the outside of a cell, are provided to override the drive motors in the event of a failure. The drive motor assemblies are grouped in a remotely interchangeable block and the arm can be disconnected remotely. (auth)

2763 DISASSEMBLY AND EXAMINATION OF NaK-COOLED IN-PILE FORCED CONVECTION LOOPS. Alfonso J. Passeri (Pratt and Whitney Aircraft, Middletown, Conn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 197-204(1962).

Remote handling techniques were developed and used successfully to disassemble two irradiated inpile loops containing NaK. Each loop was nine feet six inches long and weighed 400 pounds. The gamma radiation intensity was 10,000 r/hr at a distance of five feet from the fuel element region. The initial cuts were made in a cutoff box under vacuum. The liquid metal was drained into a storage container. After cleaning the loop, the fuel element was removed, disassembled, and examined. When the examination of each loop was completed, the larger pieces were cut up and disposed of as radioactive waste. The NaK in the storage container was reacted with 2-butoxy-ethanol and disposed of as liquid waste. All in-cell equipment operated satisfactorily. The only maintenance required was the changing of cutter wheels and bandsaw blades, which was accomplished remotely without difficulty. (auth)

2764 A CAPSULE-WELDING MECHANISM FOR BENCH OR REMOTE OPERATION. Billy D. Abram, Thomas C. Parsons, and Patrick W. Howe (Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 205-9(1962).

A compact and efficient mechanism, simple to operate, for welding aluminum capsules containing various elements to be reactor-irradiated was developed. The system assures an atmosphere of helium within the finished capsule, for heat-transfer and leak-detection purposes. The mechanism was designed primarily for remote operation with master-slave manipulators, but works equally well on the bench top for encapsulation of nonradioactive material. The capsule collet accommodates capsule diameters of $\frac{1}{2}$ to 1 in. and capsule lengths of $1\frac{1}{2}$ to $3\frac{1}{2}$ in. (auth)

2765 IN-CELL FABRICATION AND TESTING OF IRRADIATED FUEL ELEMENT CLADDING TENSILE SPECIMENS. J. E. Corrigan and R. C. Nelson (General Electric Co., Pleasanton, Calif.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 211-17(1962).

An in-cell tensile testing system was developed to measure the mechanical properties of irradiated Zircaloy-2 cladding obtained from purposely defected and intact fuel rods from the Vallecitos Boiling Water Reactor core. Curved sections of the irradiated cladding were machined into longitudinal tensile specimens using a remotely operated high speed contour milling machine. Tensile tests were performed in-cell using a tensile tester with special grips to hold the curved test specimens. Zircaloy cladding specimens with hydrogen levels up to 640 ppm and having total elongations as low as 2.0% were successfully fabricated and tested in-cell with the equipment. It was possible to fabricate specimens of this brittle nature because the original curvature of the cladding was maintained during all phases of specimen preparation and testing. (auth)

2766 IMPROVED COLLECTION EQUIPMENT FOR FISSION PRODUCT GAS. C. G. (Mike) McCormack (General Electric Co., Richland, Wash.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 233-8(1962).

Fission product gas is collected from oxide fuel elements of a wide variety of sizes and shapes. An element is opened by drilling through a vacuum seal against the element wall, established by compressing it between exchangeable, custom designed holding blocks, one of which is faced with Neoprene. The drill rod is sealed with a triple quad-ring seal, lubricated with vacuum grease. Gas samples exhaust through a 25-micron stainless steel filter, trapping particulate matter in the cell, and are pumped into glass sample bulbs by a stainless steel Toepler pump. Analysis is by mass spectrometer. (auth)

2767 GAS MEASUREMENT APPARATUS OPERATING EXPERIENCE AND TECHNIQUES AT THE CANEL HOT LABORATORY. Frank F. Felber, Jr., Vernon C. Van Sickle, and Donald R. Farmelo (Pratt and Whitney Aircraft, Middletown, Conn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 239-46(1962).

Gas measurement apparatus and handling techniques are described. The gas handling capability developed includes provision for venting fuel elements and capturing the gas quantitatively and carrier free for mass analysis. A remotely operated closed system dissolution apparatus was also developed to measure the post-irradiation helium concentration in reactor materials. Diffusion studies and vacuum fusion analysis of irradiated fuels and components are performed with the aid of a shielded high frequency induction furnace. Operating experience with the remote glass apparatus has been very favorable. (auth)

2768 A REMOTELY-OPERATED EXTERNAL TARGET SYSTEM FOR 88-INCH CYCLOTRON. Leonard E. Miles, George L. Wigle, Phillip A. Bohm, Robert G. Altes, Thomas C. Parsons, and Patrick W. Howe (Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 247-52(1962). (UCRL-10368)

The target is placed in the external beam by a placement tube which moves the target from the attachment position to intercept the cyclotron beam beyond a 4-ft shielding wall. A new target and holder were designed to provide for much higher levels of induced activity and concentrations of heat than has been experienced at previous accelerators. The placement tube, which maintains the target-holder seal and the coolant utilities, travels in an airtight containment tube which, in turn, is connected through a plastic sock to the disassembly enclosure in a 6-in. lead cave. The active target is removed from the disassembly box by a sealed-bag passout system. (auth)

2769 REMOTE MAINTENANCE OF THE MOLTEN SALT REACTOR EXPERIMENT. R. Blumberg (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 253-8(1962).

The MSRE is provided with a simple, dependable maintenance system capable of replacing all fuel-associated equipment. The best features of the manual and the fully remote techniques of maintenance are combined with a layout that reflects maintenance requirements. (auth)

2770 HOT-CELL CALORIMETRY FOR ROUTINE DETERMINATION OF THERMAL POWER GENERATED BY KILOCURIE SOURCES. J. C. Posey, T. A. Butler, and P. S. Baker (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 263-8 (1962).

Calorimeters were developed to measure the thermal power of multikilocurie radioactive sources of Sr^{90} and Cs^{137}. The calorimeters are resistant to accidental damage, occupy little hot-cell space, and are simple to operate. Measurements are accurate to ±0.20% when measuring ~20 watts of thermal power. (auth)

2771 TARGET-HANDLING SYSTEM FOR THE 60-INCH CYCLOTRON. George L. Wigle and E. S. Fleischer

(Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 269-73(1962). (UCRL-10372)

Descriptions of the target cart and dismantling shield for the 60-in. cyclotron are given. Means were provided for moving the target from the accelerator area to a shielded box where the target assembly was dismantled. The shield permitted each section of the target assembly to be visually inspected, to be checked for alpha, beta, and gamma activity, and to be sealed in plastic bags before being passed out of the shielded area. A contaminated box was readily replaced with a completely equipped standby unit. (auth)

2772 RESEARCH FACILITY FOR THE SYNTHESIS AND FABRICATION OF REFRACTORY PLUTONIUM MATERIALS. F. A. Saulino, J. C. Andersen, and K. M. Taylor (The Carborundum Co., Niagara Falls, N. Y.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 277-86 (1962).

A facility for studying the synthesis and fabrication of refractory plutonium materials is described. The outstanding features of the facility are its compactness, reliability, low operating cost, and the unusually high purity of the atmosphere in the helium glove boxes (2-3 ppm oxygen and less than 1 ppm water vapor). The high purity helium atmosphere results from the leak tightness of the system and the highly effective zirconium-titanium alloy getter system. In addition to the usual health and safety precautions, possible trouble areas are continuously monitored by an extensive alarm system. (auth)

2773 AN ENGINEERING-SCALE HIGH-ALPHA FACILITY FOR PLUTONIUM FLUORIDE VOLATILITY PROCESS STUDIES. G. J. Vogel, E. L. Carls, W. J. Mecham, and A. A. Jonke (Argonne National Lab., Ill.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 287-92(1962).

An outline of the Fluoride Volatility Process is presented along with descriptions of the alpha containment boxes and equipment and discussion on the ventilation air and process off-gas handling schemes, critical path method for planning and scheduling construction jobs, and purchase cost data for various sizes of Chemical Engineering Hood, Alpha Modular (CENHAM) boxes. In the process the separation of fuel element components (uranium, plutonium, and fission products) is based on the chemical and physical properties of the fluorides formed by fluorinating a dejacketed element at 500°C in a fluidized bed reactor. (P.C.H.)

2774 THE ADAPTATION OF COMMERCIALLY AVAILABLE STOCK PARTS INTO AN INEXPENSIVE GLOVE-BOX TRAIN. A. J. Banslaben and H. L. Finston (Brookhaven National Lab., Upton, N. Y.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 293-8(1962). (BNL-6293)

By adapting commercially available stock parts designed for other purposes, an interconnecting train of glove boxes was fabricated at a considerable saving in cost over that required for a custom-designed system. They key feature is the utilization of a glass-fiber reinforced polyester vat liner commonly used in chemical processing. Introduction ports, transfer locks, and ventilation system were fabricated from PVC pipe and fittings and Teflon-sealed valves. Components can be assembled with conventional shop tools and a vacuum-tight bond effected with glass-fiber tape and polyester resin. The system is admirably suited to the handling of alpha-emitters. (auth)

2775 UNITED NUCLEAR CORPORATION PLUTONIUM FACILITY. Dumont Rush (United Nuclear Corp., White Plains, N. Y.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 313-20(1962).

A plutonium facility was designed and built to produce fuel samples and obtain data on their irradiation behavior for long burnups at high power generation rates. The facility has ten glove boxes and two hoods for the preparation of plutonium fuel elements and samples, and for out-of-pile examination for weight, dimension, density, microscopic structure, thermal expansion at high temperature, melting point, vapor pressure and quantitative chemical composition. In all but the chemistry boxes and hoods, the box atmosphere is either nitrogen or helium, with careful control over oxygen and water vapor content, and maintained at less than ambient pressure. The facility is engaged in a mixed-carbide fuel development program and during more than a year of operation there has been no detectable alpha contamination outside the boxes. (auth)

2776 AN AIR PROPORTIONAL ALPHA HAND AND SHOE COUNTER. Robert J. Walker and William J. Roach (Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 321-4(1962).

A need for sensitive, stable alpha hand and shoe monitoring equipment was met by a transistorized air proportional instrument. Many features incorporated in the design were first used in portable alpha survey meters for several years and have demonstrated reliability. The large-area air proportional detectors are unaffected by penetrating background radiations or rf or magnetic fields. They have a uniform surface response and 16% efficiency at 5 Mev. Novel pedestal-type packaging and transistorization resulted in a compact, efficient, and attractive instrument. Maintenance is much less than for scintillation-type counters. (auth)

2777 AN ENCLOSURE FOR HUMAN PATIENT RADIOISOTOPE THERAPY. Will D. Phillips and Graham M. Hairr (Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 325-8(1962).

A gloved enclosure suitable for housing human patients was designed and constructed. Patients being treated with massive whole-body doses of chelated Y^{90} have remained for 24 hours in this enclosure in relative comfort. The radioisotope was completely contained within the enclosure system. (auth)

2778 A COMPACT INERT-ATMOSPHERE ENCLOSURE FOR ALPHA AND LOW-LEVEL BETA-GAMMA OPERATIONS. Will D. Phillips (Univ. of California, Berkeley). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 330-2(1962). (UCRL-10369)

The design of a compact, inexpensive inert-atmosphere enclosure constructed of sheet metal and plexiglas is given. The enclosure was intended for use with alpha and low-level beta-gamma emitters, but is suitable for any oxygen-free or moisture-free work. The basic enclosure consists of a welded and flanged sheet metal box open at the top. It is 20 in. wide, 17 in. from front to back, and 10 in. high, and has an approximate volume of 2.2 ft^3. The cost for one of the enclosures is estimated at under $300. (P.C.H.)

2779 A PULVERIZER-MIXER FOR SOLIDIFIED MOLTEN SALT REACTOR FUEL SAMPLES. M. J. Gaitanis, C. E. Lamb, and L. T. Corbin (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 333-4(1962).

A pulverizer-mixer was designed for fuel salt mixtures so that an analysis, representative of the fuel, could be made. The shape of the pulverizer-mixer is designed to give maximum pulverizing action on the salt by the ladle

(or by a ball if the sample is not ladle encased). The device is also designed to be placed in a shielded cell with all manipulation performed with master-slave manipulators. (auth)

2780 REMOTE DECAPPER. W. L. Maddox (Oak Ridge National Lab., Tenn.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 335(1962).

Description is given of a bottle clamp that was redesigned in order to eliminate the need for operating a screw clamp with manipulator hands. The new clamp consists of a bottle receptacle and two rubber-faced jaws that hold the bottle under light spring tension. (P.C.H.)

2781 GAMMA ASSAY SYSTEM. James B. Deal (Los Alamos Scientific Lab., N. Mex.). Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962: 336-7(1962).

A gamma assay system was developed which measures the relative activity of sources located inside a hot cell. Gamma active La^{140} sources ranging in size from 10 mC to 10,000 C (or other sources of equivalent activity) can be measured to an accuracy of ±15%. The system consists of an air filled ionization chamber mounted in a wall plug assembly plus an electrometer to measure the current. To perform the measurement the plug assembly is inserted into the hot cell wall, the electrometer is connected to the plug, and the source is positioned along the axis of the plug assembly. (P.C.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

Refer also to abstracts 2757, 2777, 3679, 3706, and 3730.

2782 (BLG-103) CONTRIBUTION A L'ETUDE DE LA RETENTION DU Sr^{90} DANS LE SOL. (Contribution to the Study of the Retention of Sr-90 by Soil). J.-P. Krotoszyner and R. Kirchmann (Brussels. Centre d'Etude de l'Energie Nucléaire). Oct. 1961. 17p.

Experiments on the retention of Sr by three soil types are discussed. For each of these soils we chose two horizons for each of which we determined the degree of humus, clay, and calcium. A granulometric analysis of these substrata was carried out. In a first series of experiments the soils were introduced into percolation columns and saturated by Sr^{85} and Sr^{90} labelled stable Sr. A $BaCl_2$ solution was then percolated in order to flush the Sr retained by capillarity and to determine the exchangeable fraction of strontium. The results show that the exchange proceeds quickly and that the absorption is mostly influenced by clay and humus. In a second series, three surface horizons were shaken in the presence of carrier-free Sr^{90}. According to the results the examined horizons display no differences in absorption speed or in quantity of retained Sr^{90}. In the conditions of our experiments the retained Sr^{90} quantities scatter from 89.3% to 97.8% according to the horizon and the shaking period. (auth)

2783 (BNL-6362) THE ANALYSIS OF CELL POPULATION KINETICS. Henry Quastler (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 25p.

The relation between true kinetic parameters of cell populations and the statistics used in studies on cell populations is discussed. It is pointed out that responses in cell populations are complex and subject to many perturbations. Some of these are discussed. It is concluded that a complete check list of sources of error is required for studies of great accuracy, and a calculus to help in combining heterogeneous data is needed for studies of systems of great complexity. (C.H.)

2784 (ORNL-3347) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1962. (Oak Ridge National Lab., Tenn.). Nov. 12, 1962. Contract W-7405-eng-26. 180p.

Separate abstracts have been prepared for 5 sections of this report. (C.H.)

2785 (ORNL-3347(p.1-46)) RADIOACTIVE WASTE DISPOSAL. E. G. Struxness, R. J. Morton, and F. L. Parker (Oak Ridge National Lab., Tenn.).

It now seems likely that initial application of deep-well liquid injection techniques will be in the disposal of high-volume, low-level process waste water that will require containment for about 200 yr due to the presence of Sr^{90}. Studies on the exchange properties of Sr, Ca, Cs, and Ru with soils led to the conclusion that the restricted movement of radionuclides compared to water would make it possible to use a deep aquifer as a large ion exchange bed, rather than just as a storage basin. A study was made of the feasibility of disposing of liquid radioactive waste by mixing with cement, or some other hardening agent, and then injecting the slurry deep into bedded rock through a specially constructed well. The development and testing of suitable mixes are discussed and results are reported from a three-year field test. The feasibility of disposal of solidified high-level liquid wastes in salt formations was also investigated. Canned ETR fuel assemblies were used to simulate the solidified wastes in heat generation and radioactivity. Laboratory studies were made on the effects of temperatures greater than 80°C on the physical properties of salt. Studies were continued on the fate of radioisotopes released to the Clinch River, the diluting capacity of the river system, and the long-term effects of radioactive contamination on the fluvial environment. A map of the Clinch River basin, showing location of sampling stations, is included. Data are included from an intensive study of sources of contamination and movement of radionuclides in the White Oak Creek drainage area. Studies were continued on ion exchange reactions of fission products with various minerals, with emphasis on the removal of Cs^{137} and Sr^{90} from waste solutions. A study was undertaken to evaluate the economics and hazards associated with alternative methods for ultimate disposal of highly radioactive liquid and solid wastes. Preliminary data are presented. (C.H.)

2786 (ORNL-3347(p.47-72)) RADIATION ECOLOGY. S. I. Auerbach (Oak Ridge National Lab., Tenn.).

Samples taken in 1961 from White Oak Lake bed showed concentrations of radionuclides in plants and herbivorous insects were essentially unchanged since 1958. Significant concentrations of 10 radionuclides were detected in the carcasses of 26 small mammals from the White Oak Lake bed. Metaphosphate glass rods were adopted as *in vivo* dosimeters for estimation of dose accumulated by wild mammals. Experiments were performed to determine the response of the fluorods to the radiation energy spectrum from mixed radionuclides in the soil. Cotton rats tagged with 100-μc Ta^{182} wires were released for environmental studies. Basic blood studies were conducted on wild mammals from uncontaminated areas preliminary to studies on the possible effects of radiation on the blood picture in mammals from contaminated areas. Analog computer methods were used to simulate changes in succession and Cs^{137} redistribution in a herbaceous ecosystem. Studies were continued on the aquatic ecology of the Clinch River and the fate and effects of radionuclides released in waste solutions. Results are presented of tracer studies in insects and arthropods are given. The cycling of Cs^{134} in white oak trees was studied over a 2-yr period; results are discussed. (C.H.)

2787 (ORNL-3347(p.73-100)) RADIATION PHYSICS AND DOSIMETRY. (Oak Ridge National Lab., Tenn.).

Investigations on the electromagnetic properties of a plasma-beam system led to the establishment of a formal analogy between the Vavilov-Cherenkov effect produced by a single particle passing through a thermal plasma and the longitudinal instability produced by a beam having the same velocity as the particle. Investigations were made on the Vavilov-Cherenkov effect and so-called Bohr radiation produced by a beam of charged particles in a dispersive medium, and the distant ionization produced by heavy ions in tissue. A calculation of the dose due to high-energy radiations was begun in which machine codes will be used to provide tapes with the histories of particles arising in shielding materials or tissue phantoms from bombardment with protons and neutrons of energies up to several billion electron volts. A code will be developed for the calculation

of the rad and rem dose in a tissue slab, with the particle histories used as input. The dependence of rbe on the physical characteristics of radiation was investigated. A model for spontaneous and radiation carcinogenesis is presented and discussed. Investigations of the theoretical physics of dosimetry included studies on positron annihilation in a free electron gas, the absorption of photons in metals due to electron-electron collisions, the surface absorption of photons in metals, and optical bremsstrahlung in a dielectric foil medium irradiated by charged particles. Studies were continued of alpha-particle ionization of binary mixtures of gases containing argon in which it is assumed that two excited states in argon may transfer energy to the added gas. Data are tabulated for 13 binary gas mixtures with argon. Experimental studies were made of low-energy electron capture and drift velocity in several binary gas mixtures containing a polar component. A new method is described that was developed to study the motion of individual electrons in a swarm. Investigations were continued on visible and ultraviolet light emitted by thin Ag and Au foils irradiated by high-energy electrons. Design changes and tests were made on a spherical electrostatic high-transmission, low-energy β spectrometer. The positron flux emitted to a flat Cu disk containing Cu^{64} and from a cavity source of Cu containing Cu^{64} was measured. An energy correction shield was designed for an RCL 10-60 halogen-filled G-M counter that increases sensitivity when used as a low-level γ dosimeter. The operation of the Health Physics Research Reactor during experiments at the Nevada Test Site Operation BREN is discussed and a plot is included of facilities for the Dosimetry Applications Research (DOSAR) site at ORNL. A study was continued on the disposition of energy in biological materials absorbed from ionizing radiation. Thin layers of powdered trypsin, tyrosine, phenylalanine, and tryptophan were irradiated under an atmosphere of helium with 230 kvp x rays at 77°K and the intensities of the immediate luminescence emitted during the irradiation and the thermoluminescence emitted upon subsequent heating were recorded through a series of interference filters spanning the spectral region 2500 to 7500 A. The importance of surface effects on thermoluminescence was illustrated by similar measurements on salt crystals of various sizes. (C.H.)

2788 (ORNL-3347(p.101-41)) INTERNAL DOSIMETRY. (Oak Ridge National Lab., Tenn.).

A metabolic model and computer programming methods developed for estimating intake of Pu^{239} to blood from urinalysis data were reviewed and checked against data from hospital patients with body burdens of Pu^{239}. It was concluded that the methods are sound in principle but accuracy can be improved. A statistical evaluation was made of the dose to man of stable elements resulting from a constant level of contamination in the environment. The statistical treatments are applied to data on trace elements in human tissue in adult subjects and attempt to delineate the effects of individual variations correlated with age, sex, weight, and individual habits. Illustrative examples and confidence bonds are given for the distribution of Ra^{226} in total skeletal ash of cadavers, ages 20 to 91, from New York City, the distribution of Sr/Ca ratios in British stillbirths, and the distribution of Al in lungs of adults, ages 20 to 59, in U. S. urban populations. A total of 967 samples of 27 types of tissues was analyzed for 23 elements by spectrographic analysis. Average values are tabulated for tissues from San Francisco, New York, and Atlanta, Georgia. Statistical analyses were made of data from a group of 150 adults who died suddenly and whose tissues showed no gross pathologies. The data will serve as a base line in future studies. Representative data are tabulated. Radioautographic and microscopic studies were made of uranium distribution in rat kidney. Pathological conditions observed in tissues from rats given different doses and sacrificed at different post-injection times are compared with disintegrations observed on the radioautograms. Results are included from a comparison between the disintegrations found by radioautographic and biochemical methods. (C.H.)

2789 (ORNL-3347(p.142-54)) HEALTH PHYSICS TECHNOLOGY. B. R. Fish (Oak Ridge National Lab., Tenn.).

Comparisons were made of three methods of measurement of surface contamination. The three methods included the smear or wipe technique, the adhesive paper technique, and a procedure that employs impingement to remove loose contamination from a surface. No consistent correlations were found between results obtained by these methods for a number of test surfaces. Data are presented on the characteristics of submicron aerosols of 18 different metals produced with an exploding wire aerosol generator by wire explosions in air and in argon at barometric pressure. Whole-body counting, using a γ-ray spectrometry facility, was carried out on 102 people with known or suspected contamination exposure. Data are tabulated on the measurable activity found. Cattle thyroid glands and milk samples were analyzed for I^{131} content. The efficiency of the anion exchange procedure for the recovery of I^{131} from milk was tested. A survey of bioassay procedures adequate for detecting significant radiation exposures of the crew of a nuclear submarine showed that direct γ-ray spectrometry of raw urine samples was adequate for detecting significant chronic or acute internal exposures to gross mixtures of radioactive corrosion products or fission products. This method uses equipment already aboard ship. Data are tabulated on total excretion of Sr^{90} by man during the first 22 days after exposure and procedures used in the mathematical analysis of Sr retention and excretion data are discussed. (C.H.)

2790 (UCLA-505) A DEVICE FOR CONTAMINATING GRAINS WITH RADIOACTIVE MATERIAL. Theodore Y. Tagami (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). June 1962. Contract AT(04-1)-Gen-12. 14p.

This report describes a machine designed to contaminate rodent diets such as rolled oats and pearled barley with radioactive material. The machine consists of a vertical cylinder with a funnel-shaped bottom in which the grain is tumbled by a jet of compressed gas. An isotope solution is atomized in the gas stream as it is injected through the base of the cylinder. The exhaust gases are decontaminated by a dust filter and an activated carbon filter. The unit is powered by compressed nitrogen and is capable of contaminating a quantity of grain evenly with minimum wetting. From 68 to 81% of the isotope can be deposited on the grain. The remainder is removed from the gas stream by dust filters and carbon absorbers. Some loss of grain may result from abrasion during mixing. The machine is housed in an airtight box and operated remotely. (auth)

2791 IMPLANTATION OF ASCITIC TUMOR CELLS AND OF METASTATIC EMBOLI FROM BODY FLUIDS INTO TISSUES: ITS INHIBITION BY CHEMICALS AND RADIOISOTOPES. Horace Goldie and Matthew Walker (Meharry Medical Coll., Nashville). Acta Unio Intern. Contra Cancrum, 16: 633-41(1960). (In English)

A series of microscopic preparations showed various stages of free tumor cell implantation from the peritoneal

fluid into peritoneal tissue of the mouse. The dependence of this phenomenon on topical and systemic factors is discussed. The possible vulnerability of metastatic tumor growth for chemotherapy and isotope therapy was demonstrated in implanted free tumor cells treated with triethylenethio-phosphoramide; 6-amino-nicotinamide, colloidal Au^{198}, P^{32} as chromic phosphate, and Y^{90} as chloride. (C.H.)

2792 USE OF RADIOACTIVE ARSENIC (As^{74}) IN THE DIAGNOSIS OF SUPRATENTORIAL BRAIN TUMORS. E. H. Botterell, W. M. Lougheed, T. P. Morley, R. R. Tasker, and W. Paul. Can. Med. Assoc. J., 85: 1321-8 (Dec. 16, 1961).

Results are reported in 350 patients examined by external scanning of the head for the detection of supratentorial tumors after the administration of As^{74}. Twenty-four out of 26 meningiomas were detected and 10 out of 27 glioblastomas. In all tracer studies using P^{32}, I^{131}, As^{74}, and K^{42}, the lesions with the greatest cellularity appear to retain the isotope in greatest concentration. On the other hand, Na^{24} concentrates very poorly in brain tumors; probably due to the fact that Na naturally occurs mainly in the intercellular compartment. Assays of injected As^{74} recovered in brain tumors show highest values in meningiomas, followed, in order, by glioblastomas, metastic carcinomas, and astrocytomas. This correlates with the ease with which the different tumor types can be detected by scanning, and it also correlates with tumor detection using P^{32} and I^{131}. Whatever the isotope used, it is the cellular tumors that are detected. No tracer method has yet been developed which will detect the tumor of sparse cellularity by an increase in radioactivity. (H.H.D.)

2793 CONTROL OF THE PROCESS OF MUTATION IN CANCER CELLS. N. P. Dubinin, L. V. Cherezhanova, and E. K. Bulochnikova (Inst. of Biological Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 146: 917-20(Oct. 1, 1962). (In Russian)

The high degree of cell mutability during the growth of a cancer is evidenced by the large number of chromosomal rearrangements observed in each generation during the multiplication of cancer cells. Streptomycin was previously found to possess protective properties against the effects of γ radiation, ultraviolet light, and α particles. It also possesses antimutagenic properties in that it can suppress the natural mutation process in onion shoots and in the sperm of Drosophila. Streptomycin was used to suppress the mutation process in cancer cells of mice with Ehrlich ascites carcinoma. A standard solution containing 70 to 100 thousand ascites cancer cells per 1 mm^3 was made up, and incubated for 2 to 4 hours at 37°C with 0.1, 0.01, and 0.001 γ of streptomycin per ml. Then, 15 to 20×10^7 cancer cells were injected into the mice. After 26 hours, the infected mice were opened up, and smears were taken in order to determine the number of chromosomal rearrangements. The number of mutations in the ascites tumors decreased by a factor of 2 for the cancer cells treated with streptomycin, as compared to the controls. High doses of streptomycin (treatment of the suspension of ascites cells with 10, 13, 25, 33, and 50 thousand γ per ml of streptomycin) showed a clear mutagenic effect on the second and fourth mitosis (but not on the first mitosis). These experiments open up the possibility of using antimutagenic agents as a means of controlling the process of mutation in cancer cells. (TTT).

2794 CLINICAL NUCLEAR INSTRUMENT MEASURES BLOOD VOLUME. John A. Williams (Beth Israel Hospital, Boston) and James B. Williams. Nucleonics, 20: No. 11, 63-4(Nov. 1962).

A method for determining the blood volume to within 2% in less than 15 min is described which uses the instrument Volumetron. The method is based on the dilution principle; a radiotracer such as I^{131} or Cr^{51} is counted and injected, and after 10 min a sample of the blood is withdrawn for counting. The Volumetron computes the blood volume automatically. (D.L.C.)

2795 ON THE GEOMETRICAL CONSTRUCTION OF TRABECULAE OF HUMAN BONE. Haruma Yoshinaga and Shigetoshi Antoku (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 3, 39-43(1962). (In Japanese)

In view of the currently held theory that the increased incidence of leukemia is related to the irradiation of the bone marrow, a detailed description of the size and structure of the trabeculae of the human bone is given for the purpose of aiding in the calculation of the irradiation dose to the bone marrow. The distance between individual trabeculae was found to be about 50 microns; their thickness varied between 100 and 200 microns while the diameter of the bone cortex was found to be between 200 and 500 microns. From these measurements it was concluded that no secondary electrons are egenerated in the bone marrow exposed to radiation. (TTT)

Biochemistry, Nutrition, and Toxicology

Refer also to abstracts 2714, 2715, 2716, 2717, and 2718.

2796 (HW-SA-2700) DISTRIBUTION AND REMOVAL OF TRANSURANIC ELEMENTS AND CERIUM DEPOSITED BY THE INHALATION ROUTE. W. J. Bair, E. G. Tombropoulos, and J. F. Park (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 16, 1962. Contract AT(45-1)-1350. 32p.

Tissue distribution and excretion of inhaled plutonium varied with the chemical form and the particle size of the aerosols. In dogs, thirty days after inhalation of plutonium nitrate, 70% of the body burden was in the lungs, 12% in liver, 15% in the skeleton, and 3% in all other tissues. After inhalation of $Pu^{239}O_2$ with a mass median diameter (MMD) of 0.23 μ, 71% of the body burden was in lung, 3% in bronchial lymph nodes, 4.4% in muscle, 1.3% in skeleton, and 20% was distributed throughout all remaining tissues. After inhalation of $Pu^{239}O_2$ aerosols with MMD's of 2.3 to 7.6 μ, the lungs contained 98%, the bronchial lymph nodes about 1%, and all other tissues the remaining 1%. Three weeks after inhalation of Np^{237} as a contaminant of an industrial dust the lungs of rats contained 50% of the body burden. These and excretion data defined the relative importance of the three routes by which inhaled radioactive isotopes were cleared from the lung, e.g., movement up the trachea by ciliary action followed by excretion in the feces, transport across the alveolar membrane to other tissues and/or excretion in urine, and transport to the bronchial lymph nodes which accumulate inhaled insoluble materials. Therapy agents were tested that would be expected to increase the clearance of radioactive isotopes from the lung by routes which would avoid accumulation in other, perhaps more radiosensitive tissues. These included chelating agents, wetting agents, irritants, sympathomimetic, parasympathomimetic, parasympatholytic, and anti-histamine drugs. Diethylenetriamine-pentaacetic acid (DTPA), a chelating agent, administered by aerosols or intraperitoneally caused rapid transport of Ce^{144}-Pr^{144} from the lung and from the body via urinary excretion. One month after exposure to Ce^{144}-

Pr^{141} treated rats and dogs retained less than 10% of the Ce^{144}-Pr^{144} levels of untreated animals. Polypropyleneglycolethylene oxide polymer (Pluronics F68), and to a lesser extent, DTPA, increased the rates of urinary and fecal excretion of inhaled plutonium, but were much less effective than they were in removing Ce^{144}-Pr^{144}. (auth)

2797 (HW-SA-2763) REMOVAL OF PLUTONIUM AND OTHER TRANSURANIC ELEMENTS FROM MAN. W. D. Norwood (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Sept. 24, 1962]. Contract AT(45-1)-1350. 16p.

Hazards from the deposition of Pu^{239} and other transuranic elements in humans are discussed. The distribution of the radionuclides in the body and modes of entry are reviewed. Recent advances in the elimination of Pu depositions from humans are described. The treatment of 5 men who had harbored small quantities of Pu^{239} for a variable number of years and of one man who had recently received an innoculation of 1 μc of Pu^{239} via a deep puncture wound with the trisodium-calcium salt of diethylenetriaminepentaacetic acid (DTPA) is discussed. It is pointed out that the benefits must be balanced against the hazards of the therapy. (C.H.)

2798 (HW-SA-2764) Cs-137 EXCRETION AND BODY BURDENS IN ALASKAN ESKIMOS. H. E. Palmer, W. C. Hanson, and B. I. Griffin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 21, 1962. Contract AT(45-1)-1350. 7p.

The Cs^{137} body burdens of 700 Eskimos in northern Alaska were measured using a transportable whole-body counter. Urine samples excreted during a 24-hr period were collected from 15 Eskimos. Data are tabulated. The body burdens of Cs^{137} in these Eskimos were much higher than the average body burden in the rest of the U. S. The high body burdens of Cs^{137} were attributed to the high levels of Cs^{137} in reindeer and caribou that comprise a large part of the diet. The source of the Cs^{137} was attributed to fallout on lichens eaten by the reindeer and caribou. The retention capacity of lichens for fallout radionuclides is nearly 100%. (C.H.)

2799 (LADC-5446) DETERMINATION OF BODY POTASSIUM BY 4π GAMMA COUNTING. Ernest C. Anderson (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 44p.

This paper summarizes the results of a 7-year study of the potassium content of the human body using 4π liquid scintillation counters. The long-term precision of the system, as determined by 155 measurements of a control milk sample containing 413 grams of potassium, is ± 5 grams K or 1.3% (one standard deviation) on individual measurements and ± 2 grams K or 0.5% on yearly averages. Using a routine procedure of 200-second counts with background measurements hourly, the precision of determination of human potassium is ± 5 grams or 3.7% on an adult male subject. More frequent determination of background reduces the deviation to the purely statistical error of 2.6 grams K or 2%. The biological stability of body potassium in a healthy subject of constant body weight is better than 2 grams over a period of years. Absolute accuracy of the method, as judged by comparison with other methods of determination of body potassium, is better than 3%.

2800 (TID-14151) THE APPARENT RETENTION OF CESIUM^{137} IN HUMAN RIB BONE. Robert W. Anderson and Phillip F. Gustafson (Argonne National Lab., Ill.). Sept. 1961. Contract [W-31-109-eng-38]. 7p. (UAC-5664)

Low level gamma counting facilities were utilized to determine the quantitative presence of the fission product Cs^{137} in human rib samples from various age groups. Based on the data obtained, several possible interpretations are proposed and the possibility of age-dependent mechanisms of cesium retention is pointed out. (auth)

2801 (TID-17191) THE NATURAL CONTENTS OF RaD (Pb^{210}) AND RaF (Po^{210}) IN THE HUMAN BODY. Richard B. Holtzman (Argonne National Lab., Ill.). Aug. 1962. Contract W-31-109-eng-38. 19p. (UAC-6793).

Results are reported from measurements of naturally occurring RaD, RaF, and Ra^{226} in surgical and autopsy specimens of soft tissue and bone. Applications of the data in estimates of the internal dose rate due to RaD and its daughters relative to that from the Ra^{226} chain are discussed. Problems involved in determining the distribution of RaF-RaD in the skeleton are considered. It is concluded that because of the lack of correlation between RaD and Ra^{226} concentrations, the relative dose rates cannot be defined for human populations as a function of geography (C.H.)

2802 (TID-17200) THE TRANSLOCATION OF Ra DAUGHTERS TO THE SKELETON OF THOROTRAST PATIENTS. L. D. Marinelli and H. F. Lucas (Argonne National Lab., Ill.). Aug. 14, 1962. Contract [W-31-109-eng-38]. 10p. (UAC-6756).

The skeleton and bone marrow of Thorotrast patients were analyzed for activity from Th^{232}, Ra^{228}, and Th^{228}. Data are tabulated. Transport parameters for Ra^{228} and Ra^{224} and the equilibrium status of the chain in the reticuloendothelial system are discussed. It is suggested that data from these patients offer unique opportunities to students of bone physiology since several radioactive elements are injected into the circulation at a constant rate for long periods of time. (C.H.)

2803 (JPRS-16496) BERYLLIUM: TOXICOLOGY, CLINICAL ASPECTS OF DISEASES, LABOR HYGIENE. V. M. Kozlov and V. D. Turovskii (Turovskiy). Translation of "Berilliy: Toksikologiya, Klinika Porazheniy, Gigiyena Truda" (a publication of the State Publishing House for Literature in the Field of Atomic Science and Technology, Moscow, 1962). 33p.

The toxic effects of beryllium when introduced into the bodies of animals by various means are reported. Protection of human beings from beryllium poisoning by means of special clothing and medical examinations is discussed. Methods are described for preventing environmental contamination from beryllium industrial operations. (R.J.S.)

2804 INVESTIGATION OF THE MECHANISM OF ENZYMATIC CARBOXYLATION OF PHOSPHOENOLPYRUVATE. Hitoshi Maruyama and M. Daniel Lane (Virginia Polytechnic Inst., Blacksburg). Biochem. Biophys. Res. Commun., 9: 461-5(Nov. 27, 1962).

Reaction mechanisms involved in enzymatic carboxylation of phosphoenolpyruvate (PEP) in carboxylase were studied. Carboxylase isolated from germinating peanut cotyledons was used in the studies. Results suggest that in the reaction catalyzed by PEP carboxylase the bicarbonate, or carbonate, ion rather than CO_2 is the active substrate species involved, and nucleophilic attack by the bicarbonate, or carbonate, anion on the electrophilic phosphoryl P atom of PEP is involved. (C.H.)

2805 STRONTIUM-90. J. F. Loutit (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. Med. J., 2: 369(Aug. 5, 1961).

Assuming total body Ca to be 1000 g, it is estimated that 2 mμc of Sr^{90}/g Ca in the body would deliver a dose of 6 rem/yr. But a conservative level, allowing only one-tenth

of the dose for the population as a whole and taking one-third this as the safe level, the maximum permissible Sr^{90} level would be 67 μμc/g Ca. Estimates made on still-born children showed that the newborn infant had ~1 μμc Sr^{90}/g Ca. This level rose to a maximum between the ages of 1 and 2, and 1- to 2-year-old children had ~4 μμc Sr^{90}/g Ca in 1959 and 3 in 1960. Less than 1 μμc was found in adults. (H.H.D.)

2806 P^{32}-TESTS FOR INVESTIGATING THE COMPETITION BETWEEN TREE ROOTS AND REGROWTH IN SOUTHERN TAIGA FORESTS. V. G. Karpov. Dokl. Akad. Nauk SSSR, 146: 717-19(Sept. 21, 1962). (In Russian)

Introduction of radioactive materials into soil nutrients represents an excellent tool for determining utilization of the nutrient and its ultimate distribution between the various components of the phytocaenosis; therefore, P^{32}-labeled solutions were used for clarifying the competition between the roots of mature birch, Betulla verrucosa, and fir, Picea excelsa, seedlings. The test area contained 30- to 35-year-old trees at a density of about 7 to 8 thousand trees per hectare. During the summer of 1960 fir seedlings were planted in areas removed from the influence of the birch roots and near the trees without interfering with interaction between the 2 systems; at the latter location the soil contained 730 to 1100 g/m^2 of roots. In July 1961 10 mg/liter P solution, labeled with P^{32} was introduced into the soil; the original activity of the solution was 65 μc/liter. Results indicated that competition by the birch roots strongly inhibits the P^{32} uptake by the 2-year-old seedlings; the radioactivity of the fir needles planted in isolated areas was 5 to 6 times higher than that in seedlings planted near the mature trees. (TTT)

2807 THE DIFFERENCE IN UPTAKE OF RADIOISOTOPES BY MARINE AND TERRESTRIAL ORGANISMS. Ralph F. Palumbo (Univ. of Washington, Seattle). p.1367-72 of "Recent Advances in Botany." Toronto, University of Toronto Press, 1961.

The elements in radioactive fallout that form strong complexes with organic matter, such as the transition elements and some of the anions, and those that are present in the particulate or colloidal form are present in highest amounts in the marine organisms. These radioisotopes include the non-fission products $Co^{57,58,60}$, $Fe^{55,59}$, Zn^{65}, and Mn^{54} and the fission products Zr^{95}-Nb^{95}, Ru^{106}-Rh^{106}, and Ce^{144}-Pr^{144}. On the other hand, the fallout materials that are soluble are the ones taken up in highest amounts by the land plants and animals. These include Sr^{90} and Cs^{137}. (auth)

Fallout and Ecology

2808 (AEET/AM/26) MEASUREMENTS ON THE ENVIRONMENTAL RADIOACTIVITY IN INDIA FROM NUCLEAR WEAPON TESTS. DATA COLLECTED DURING 1956-61. (India. Atomic Energy Establishment, Trombay). July 1962. 152p.

Data are tabulated on the radioactivity in samples of air, rain water, tap water, milk, and other foodstuffs, and human bone collected in India from 1956 to 1962. Measurements on the content of Sr^{90} and Cs^{137} in milk have been made since 1958, and bone samples were measured for their Sr^{90} content. A brief outline is included of sampling and counting procedures. (C.H.)

2809 (CEA-Bib-22) RADIOACTIVITÉ ET ÉCOLOGIE. (Radioactivity and Ecology). R. Disdier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1962. 39p.

Summaries are presented of 94 articles published between 1948 and 1962 on the ecological effects of ionizing radiations. An author index is included. (C.H.)

2810 (ORNL-3370) STATUS REPORT NO. 3 ON CLINCH RIVER STUDY. R. J. Morton, ed. (Oak Ridge National Lab., Tenn.). Dec. 6, 1962. Contract W-7405-eng-26. 131p.

Results of chemical and radiochemical analyses of Clinch River water, animal life, and sediments are presented for the period May to October 1961. Surface-water hydrology included establishment and operation of gaging stations and stream-flow studies. (R.J.S.)

2811 (TID-17045) ION INTERACTIONS IN PLANT TISSUES. Progress Report, January 1962–January 1963. Fred H. Emmert (Connecticut. Agricultural Experiment Station, Storrs). Contract AT(30-1)-2117. 10p.

Penetration of simulated fallout P^{32} into intact plants was measured and the existence of a barrier to free passage of ion was demonstrated. Studies on the penetration of Sr^{89} into plants showed that uncontrolled buildup of Sr in plant samples occurred. Results of studies on the specific forces involved in the buildup of Sr suggest that Sr binding is by chemical combination to form a low solubility product. The oxalate system was proposed as the precipitating agent. Studies of the gradient of buildup along the stem length indicate that the site of final deposition occurred in immediate proximity to the ascending solution column in the stem. (C.H.)

2812 (TID-17229) FALLOUT I^{131} IN RENO CATTLE, MARCH 1959–MAY 1960. Clifton Blincoe (Nevada. Univ., Reno). Contract AT(04-3)-34. 4p.

Thyroid glands were removed at slaughter from cattle processed by a commercial packing plant at Reno, Nev., from March 1959 through May 1960. With few exceptions this plant processes only locally produced animals. The thyroid glands were analyzed for I^{131} content. Data are presented graphically. An analysis of the data indicates that some process other than nuclear testing is contributing to levels of I^{131} in the biosphere at a reasonably constant rate and in copious quantities. The principal known source of I^{131} that could contribute this level is exhaust gases from nuclear reactors and associated fuel reprocessing plants. The possibility of some unknown natural process cannot be ruled out. The effects of or results of extended snowfall and the detonation of two small nuclear devices by the French in North Africa in February and April 1960 are discussed. (C.H.)

2813 KRYPTON-85 IN THE ATMOSPHERE. Kunihiko Kigoshi (Gakushuin Univ., Tokyo). Bull. Chem. Soc. Japan, 35: 1014-16(June 1962). (In English)

The activities of atmospheric krypton-85 were measured on the samples of krypton collected in Tokyo. The observed activities show a remarkable increase after May 1960, which can not be explained by the production of krypton-85 by nuclear tests. The slow increase before May 1960, does not contradict an assumed parallelism between the behavior of the man-made carbon-14 in the atmosphere and that of the krypton-85 produced by nuclear tests. (auth)

2814 CHARACTERISTICS OF PLANKTON SAMPLES FOR RADIOBIOLOGICAL ANALYSIS. A. F. Fedorov (Inst. of Fish Industry and Oceanography, Murmansk, USSR). Radiobiologiya, 2: 620-5(1962). (In Russian)

The relation between the wet and dry weight of crayfish plankton was determined, and a method is suggested for measuring the specific sea water radioactivity by the radioactivity of the plankton. Studies were made of Sr^{89}, Sr^{90}–Y^{90}, Y^{91}, and Cs^{137} transitions from plankton samples into 27% formaldehyde solution after prolonged storage. (R.V.J.)

Radiation Effects on Living Tissues

Refer also to abstract 3196.

2815 (AD-275605) LET ANALYSIS OF TISSUE IONIZATION DOSAGES FOR PROTON RADIATIONS IN SPACE. Report No. 21. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). Feb. 19, 1962. 15p.

Computations of the distribution of the ionization dosage within a spherical tissue phantom of 30 cm diameter behind three different shield thicknesses for exposure to flare-produced and Van Allen Belt protons are amended by a separate evaluation of the dose fraction produced at a LET exceeding 40 kev/micron. For the first radiation, this fraction is always smaller than 2 per cent and for the second smaller than 0.5 per cent. Separate determination of the two fractions seems advisable for assessment of the net exposure status and estimates of late effects, since damage from radiation of high LET is nonrecoverable. (auth)

2816 (AD-276049) TIME PROFILE OF TISSUE IONIZATION DOSAGES FOR BAILEY'S SYNTHETIC SPECTRUM OF A TYPICAL SOLAR FLARE EVENT. Research Report No. 22. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). [1962]. 11p.

The profound changes in the energy spectrum during build-up and decay of a solar proton beam are reflected in similar changes of the tissue ionization dose within a human target. Absolute dose rates as well as penetrating power change over a very wide range during a flare event. The grand total of surface dose (skin) behind 2 g/sq cm shielding over 64 hours equals 200 roentgens. The complex transitions of the instantaneous dose rate and integral dose within the target while the flare event is in progress are presented in a number of graphs and tables. The protraction of exposure over a period of more than 2 days indicates that time factor and recovery phenomena will produce a sizeable alleviation of the net radiation injury. (auth)

2817 (BNL-5989) STUDIES OF CELL POPULATION KINETICS IN NORMAL AND CONTINUOUSLY IRRADIATED ANIMALS. L. F. Lamberton, B. I. Lord, (London, Royal Cancer Hospital, Inst. of Cancer Research) and Henry Quastler (Brookhaven National Lab., Upton, N. Y.). [1961]. Contract [AT-30-1-GEN-16]. 19p.

The use of labelled DNA precursors in conjunction with high resolution autoradiography for the measurement of cell generation times is discussed. Some studies made in the gut and the bone marrow of continuously irradiated animals are reported. (auth)

2818 (BNL-6342) THE COMBINED APPLICATION OF LYMPH DUCT DRAINAGE AND EXTRACORPOREAL IRRADIATION OF THE BLOOD IN THE STUDY OF LYMPHOPOIESIS. E. P. Cronkite, C. R. Jansen, K. Rai, H. Cottier, and T. M. Fliedner (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 46p.

Extracorporeal irradiation of the blood was prolonged for as long as 38 hours. Red cells are injured by the radiation dose. Hemolysis may commence after 28 hours presumably due to the irradiation. Utilizing extracorporeal irradiation of the blood combined with thoracic duct cannulation, one can measure minima for net lymphocyte input into the peripheral blood from all sources other than the thoracic duct. An unusual and new pathologic picture of lymph nodes and spleen has been produced by extracorporeal irradiation of the blood. Heparin mobilization of a large pool of lymphocytes into the blood directly and via the thoracic duct must be considered in all studies utilizing heparin as an anticoagulant. The lymphocytosis produced by this mobilization is suppressed by concurrent extracorporeal irradiation. The apparent quantitative destruction of the lymphocytes by extracorporeal irradiation of the blood may permit studies of lymphocytic function hitherto not possible by direct experimentation. (auth)

2819 (BNL-6466) PROGENY TEST FROM A PITCH PINE-OAK FOREST, DAMAGED BY LOW LEVEL CHRONIC GAMMA RADIATION. Francois Mergen and G. R. Stairs (Yale Univ., New Haven, School of Forestry and Brookhaven National Lab., Upton, N. Y.). [1961]. Contract [AT(30-2)-Gen-16]. 12p.

A forest of Pinus rigida and Quercus sp. surrounding a Co^{60} radiation field were exposed to about 2 to 4.5 r/20 hr day for the pine trees and 3 to 6 r/day for the oak trees during 1960 and 1961. The trees had been subjected to varying radiation doses since 1951. Seeds from cones collected from the pine trees and acorns from the oak trees were planted. Seeds that had matured during 1958, 1959, 1960, and 1961 were available from some pine trees. All the acorns were formed during 1961. A significant decrease was noted in the germination of seeds from irradiated pine trees. This decrease in germination of the irradiated seed was associated with the total dose to which individual female parent trees were exposed prior to and during seed formation. There was a significant decrease in survival and rate of growth of oak seedlings from acorns of irradiated trees when compared with controls. The pines were observed to be much more sensitive to radiation than the oaks. Results indicate that a pitch pine forest severely damaged or killed by low-level chronic radiation could regenerate itself once radiation had ceased from seed stored in serotinous cones. Oak regeneration from seed would be dependent upon the timing of exposure in relation to the current flower and seed crop. (C.H.)

2820 (BNL-6467) CUMULATIVE RADIATION EFFECTS ON SEXUAL REPRODUCTION IN PINE AND OAK. Francois Mergen and G. R. Stairs (Yale Univ., New Haven, School of Forestry and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT(30-1)-2755. 29p.

Trees in a natural pitch pine-oak forest have been exposed to varying amounts of low-level chronic γ radiation for several years. Responses range from lethality to minute morphological changes, depending upon dose rate and species. The cumulative effects of low-level chronic γ radiation on male and female flowers, pollen production, pollen germination, and development of seedlings from seeds of irradiated mother trees are described. (C.H.)

2821 (HW-SA-2800) BIOLOGICAL EFFECTS OF INTERNAL IONIZING RADIATION. Roy C. Thompson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Oct. 15, 1962]. Contract AT(45-1)-1350. 18p.

The biological effects of radiation from radioisotopes deposited within the body are reviewed. Problems of dose distribution both in space and time are discussed. It is pointed out that exposure to an internal emitter involves continuing consequences, perhaps for a lifetime. Physiological factors that govern the entry and distribution of radioisotopes within the human, modes of entry, pathological effects, and the possibility of prophylactic or therapeutic measures are considered. (C.H.)

2822 (NP-12173) BIBLIOGRAPHY OF PAPERS PUBLISHED BY UNITED KINGDOM SOURCES FROM NOVEMBER 1960 TO APRIL 1961 ON RADIOBIOLOGICAL AND ALLIED SUBJECTS. (Gt. Brit. Medical Research Council, Radiobiological Research Unit, Harwell, Berks, England). 8p. (MRC-61-625)

A list is presented of papers published from Nov. 1960 to April 1961 by United Kingdom sources covering various phases of radiobiology and allied subjects. (C.H.)

2823 (RADC-TDR-62-102) THE EFFECT OF MICROWAVES ON THE RESPONSE TO IONIZING RADIATION. Joe W. Howland, Sol M. Michaelson, R. A. E. Thomson, and Herbert Mermagen (Rochester, N. Y. Univ. Atomic Energy Project and Rome Air Development Center, Griffiss AFB, N. Y.). Mar. 1962. Contracts W-7401-eng-49 and AF30(602)-2248. 30p. (AD-274338)

The interaction of different forms of energy that result in antagonism or modification of response in the organism is a recognized biological phenomenon. Evidence was obtained that dogs exposed to a physiologically tolerated level (100 mw/square cm) of pulsed microwaves (2800 mc) are less sensitive to ionizing radiation than animals not previously pretreated with microwaves. Simultaneous exposure to ionizing and microwave irradiation results in earlier granulocytic recovery than is seen after ionizing radiation alone. Protection by enhancement of recovery processes is considered. Lethality from whole and partial body ionizing radiation after exposure to microwaves is reduced depending on duration of previous microwave exposure. The results indicate the need for additional work with consideration of time-intensity factors of both forms of energy to permit the evaluation of these procedures in modification of injury or enhancement of recovery after ionizing radiation exposure. (auth)

2824 (SAM-TDR-62-77) ENDOGENOUS BACTERIAL INVASION OF TISSUES OF MACACA MULATTA FOLLOWING LETHAL Co^{60} IRRADIATION. Anna C. Garner, E. Staten Wynne, Walter M. Sellers, and James E. Moyer (School of Aerospace Medicine, Brooks AFB, Tex.). Mar. 26, 1962. 5p.

Forty-nine Macaca mulatta monkeys were sacrificed 2, 5, 8, 11, and 14 days after exposure to Co^{60} gamma radition approximating the LD_{50}. Bacteriologic cultures showed only one positive blood. Bacterial invasion of the submandibular node after 14 days and of the stomach wall at all postirradiation intervals of 5 days or more was statistically significant. Of the 15 Salmonella and Shigella organisms detected in animals succumbing or sacrificed, 5 or more days postirradiation, 10 were present in the stomach wall. (auth)

2825 (TID-3909(Suppl.)) AN ATOMIC RADIATION BIBLIOGRAPHY. A List of Reports Submitted to the United Nations Scientific Committee on the Effects of Atomic Radiation (Supplement). Alfred W. Klement, Jr., comp. (Division of Biology and Medicine. Fallout Studies Branch, AEC). May 15, 1962. 31p.

A list is presented of reports submitted between March 1, 1961 and April 2, 1962 to the United Nations Scientific Committee on the Effects of Atomic Radiation. Contributors included member nations and certain international agencies and organizations. (C.H.)

2826 (TID-17048) A STUDY OF CHEMICAL EFFECTS OF IONIZING RADIATION ON INDIVIDUAL AMINO ACIDS WITHIN THE INTACT AND PURE PROTEIN MOLECULES. PART I. EFFECT ON ATP: CREATINE PHOSPHOTRANSFERASE. PART II. IRRADIATION INDUCED INTERCONVERSION OF AMINO ACIDS AND CONCOMITANT CO_2 FIXATION. Description of Research and Results for Period March 1, 1962 through February 28, 1963. Felix Friedberg (Howard Univ., Washington, D. C.). Contract AT(30-1)-2735. 13p.

The adenosine triphosphate-creatine phosphotransferase activity was assayed in samples of protein and enzyme previously irradiated. Whereas in the intact protein solution histidine is most radiosensitive, methionine was found to be most labile in the corresponding amino acid hydrolysate in solution. Phenylalanine and arginine were also destroyed faster in protein hydrolyzed before radiation exposure. Incorporation into a polypeptide chain altered the radioinduced chemical changes. The decline in enzymatic activity was more rapid than the disappearance of -SH groups. The relation of -SH groups to enzyme activity and radiosensitivity of protein compounds is discussed. Amino acids formed by interconversion as a result of the γ irradiation of peptide were identified. Data are tabulated. The mechanism involved in the formation of aspartic acid from glutamic acid and concomitant CO_2 fixation was investigated in poly-L-glutamic acid irradiated in the presence of $NaHC^{14}O_3$. Radioautograms indicated activity in the position for aspartic acid. Possible reaction mechanisms involved are discussed. (C.H.)

2827 (TID-17169) TO INVESTIGATE, DEVELOP, AND EVALUATE RADIOISOTOPES FOR TELETHERAPY. Progress Report. (Arkansas. Univ., Little Rock. School of Medicine). July 23, 1956. Contract AT(40-1)-1771. 33p.

The installation, calibration, and protection survey are described for a Co^{60} teletherapy unit. Data are summarized for 227 patients with various types of neoplasms treated with external γ radiation from the Co^{60} teletherapy unit. (C.H.)

2828 (TID-17170) TO INVESTIGATE, DEVELOP, AND EVALUATE RADIOISOTOPES FOR TELETHERAPY. Progress Report. (Arkansas. Univ., Little Rock. School of Medicine). July 1, 1958. Contract AT(40-1)-1771. 24p.

Results are summarized for the use of focused grid telecobalt therapy in the palliative treatment of 45 patients with advanced cancer. Relatively large doses of radiation were delivered over a period of 10 treatment days. Pain and hemorrhage stopped and there was marked regression in tumor size in all cases. Data are summarized on 670 patients with various types of neoplasms treated with external Co^{60} irradiation. (C.H.)

2829 (TID-17171) TO INVESTIGATE, DEVELOP, AND EVALUATE RADIOISOTOPES FOR TELETHERAPY. Progress Report. (Arkansas. Univ., Little Rock. School of Medicine). July 1, 1957. Contract AT(49-1)-1771. 19p.

Safety procedures and the calibration of a Co^{60} teletherapy unit are described. Investigations were begun on the utilization of a grid with telecobalt. Data are summarized on 317 patients with various types of neoplasms who received external Co^{60} treatment. (C.H.)

2830 (TID-17189) A QUANTITATIVE STUDY OF LIFETIME SICKNESS AND MORTALITY AND PROGENY EFFECTS RESULTING FROM EXPOSURE TO PENETRATING IRRADIATION. Summary of Progress, 1962. John W. Gowen and Janice Stadler (Iowa State Univ. of Science and Tech., Ames). Contract AT(11-1)-107. 73p.

Acute effects of whole-body x irradiation on total lifetime fertility and total life-time number of progeny in mice were studied. Pronounced sex differences were noted in the response to radiation. Acute irradiations of from 0 to 320 r scarcely affected male fertility or litter size, while in irradiated females the number of litters and number of progenies decreased regularly beginning at doses of 20 r. Irradiation to either parent had no influence on the sex ratios of progeny. Chronic effects of whole-body irradiation on progenies and sex ratios of first litters were measured for each of 10 continuing generations following exposure of the first generation and exposure of all generations to 22 hrs/day continuous γ irradiation of from 1.3 to

2.6 r/day. No effects on reproduction were observed from this low-level exposure. Topics discussed include the specific effects of high-dose acute irradiation on reproductivity, the effects of x radiation on postnatal growth of mice, the effects of irradiation in utero on sterility and life span of progenies, effects of irradiation on life span and senescence, and the induction of specific gene mutations by irradiation. Data are tabulated from a survey of genetic factors influencing disease processes in mammals. Data are included on modifications in genetic effects induced by irradiation. (C.H.)

2831 (TID-17198) EFFECTS OF RADIATION ON THE GENERATION CYCLE. S. Lesher and R. J. M. Fry (Argonne National Lab., Ill.). [July 1962]. Contract [W-31-109-eng-38]. 7p. (UAC-6709)

The effects of low-dose chronic irradiation and of various dose levels of duration-of-life irradiation on the generation cycle of rapidly dividing cells was investigated in cells of the crypts of the small intestine of mice at three age levels. The generation cycle in irradiated rats was found to be faster than that in non-irradiated controls. In a cell population undergoing constant irradiation damage the damaged cells were eliminated and replaced by progeny of cells capable of division. This damage-recovery-maintenance balance results in a state where the production of new cells is not sufficient to maintain the normal steady-state production rate necessary for survival. Similarities in the response of cells to irradiation and aging are discussed. (C.H.)

2832 (TID-17201) TO INVESTIGATE, DEVELOP, AND EVALUATE RADIOISOTOPES FOR TELETHERAPY. Final Report. (Arkansas. Univ., Little Rock. School of Medicine). July 15, 1955. Contract AT(40-1)-1771. 56p.

The installation, calibration, and protection survey are described for a Co^{60} teletherapy unit. Representative treatment plans are presented for various types of tumors. (C.H.)

2833 (TID-17225) THE EFFECTS OF ULTRAVIOLET LIGHT AND GAMMA RAYS ON CELL LIPIDS AND THE PHYSIOLOGICAL ACTION OF IRRADIATED LIPIDS. Final Report. Frederick Bernheim and Karl M. Wilbur (Duke Univ., Durham, N. C.). Mar. 26, 1962. Contract AT(40-1)-1647. 7p.

Results are summarized from a series of studies on the effects of ultraviolet and ionizing radiation on the oxidation of cell lipids. It was shown that both in vitro and in vivo radiation produced oxidation products of lipids that inhibited the activity of certain oxidative enzymes, depolymerized desoxyribonucleoprotein, inhibited the division of marine eggs, and retarded bacterial growth. The presence of antioxidant activity was also demonstrated in tissues. The significant feature of antioxidant compounds with respect to the biological effects of radiation was shown to be the inhibition of the oxidation of lipids. In irradiated animals the antioxidant activity of the intestinal mucosa and the activity of phospholipase decreased. Experiments showed that radiation had not destroyed the enzyme but had inactivated the activator. Results are also summarized from a study on the effects of ionizing radiation on cell growth and protein synthesis in yeast. (C.H.)

2834 (TID-17287) INVESTIGATIONS ON MUTABILITY OF POLYGENES AND ON UTILIZATION OF INDUCED GENETIC VARIABILITY. Summary of the Results up to June 30, 1962 (Nine Months of the Term of Contract). R. E. Scossiroli (Pavia, Italy. Universita. Instituto di Genetica). Aug. 1, 1962. Contract IAEA 61/US. 11p.

Observations were collected on the R_3 progeny of plants of Zea mays irradiated with doses of 500 to 1000 r x radiation. The data were analyzed for information on the relation between dose of radiation and increase of genetic variance for quantitative traits. Data are included from an analysis of results of irradiation on genetic factors in the R_2 and R_3 generation of two varieties of spring wheat. The relation between radiation dose and genetic variability in the R_2 and R_3 generations is discussed. (C.H.)

2835 (TID-17307) DEVELOPMENT OF SELECTION METHODS FOR INDUCED SMALL MUTATIONS IN HIGHER PLANTS (WITH SPECIAL REGARD TO MUTATIONS OF YIELDING CAPACITY). Progress Report, October 16, 1961 to August 31, 1962. (Max-Planck-Institut für Züchtungsforschung, Cologne). Contract AT(30-1)-2619. 9p.

Preliminary data are reported from an analysis of barley plants grown from irradiated seeds for quantitative characters affecting yield and resistance to yellow rust. Data are included from a statistical analysis of 4,048 barley M_2-spike progenies and control lines. Results indicate that irradiation increased the variability of kernel size and kernel yield. (C.H.)

2836 (UR-618) INACTIVATION OF BACTERIOPHAGE T6 IN AN AQUEOUS SYSTEM BY HIGH-ENERGY PROTONS. Hiroshi Tanooka (Rochester, N. Y. Univ. Atomic Energy Project). Sept. 7, 1962. Contract W-7401-eng-49. 123p.

The bacteriophage T6 was irradiated by high energy protons of different linear energy transfer (LET) in order to study the effect of changing the LET in an aqueous system. The inactivation cross-section per proton remained constant for various LETs in a dilute system, resulting in a high inactivating efficiency of high energy protons per unit absorbed dose. Phages carrying the halogenated DNA were also studied in regard to the direct and the indirect inactivation by ionizing radiations. The increase of the radiosensitivity by the halogenation was found only on the direct action, suggesting the phage DNA is the principal target to the radiation. The substituted molecules themselves, 5-bromodeoxyuridine and 5-iododeoxyuridine, were irradiated in an aqueous solution, showing the ring structure of the molecules is of the same degree of radiosensitivity as the normal component in DNA, thymidine, and not responsible for the increase of radiosensitivity. (auth)

2837 THE USE OF ISOIMMUNE SERA FOR IDENTIFICATION OF HEMOPOIETIC CELLS FROM BLOOD-INJECTED RADIATION CHIMERAS. Joan Wright Goodman (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 97: 95-103(May 3, 1962).

Use has been made of the antigenic differences among mice with respect to both erythrocytes and nucleated cells to identify hemopoietic cells of radiation chimeras. By employing isoimmune sera in agglutination and cytotoxic techniques, it has been shown that long-term leukemoid blood chimeras contain lymphocytes, erythrocytes, and nucleated bone marrow cells of the blood-donor type; blood from normal mice can repopulate lymphoid tissues of radiation-bone marrow chimeras, and the blood-derived cells might take part in graft-versus-host immune reactions; and normal peripheral leukocytes from F_1 hybrid donors can re-establish lymphopoiesis, granulopoiesis, and erythropoiesis when injected into lethally irradiated parent strain mice. Cytotoxic typing of the nucleated hemopoietic cells shows that they are of donor origin. (auth)

2838 CHANGES IN THE SEMINAL VESICLE OF ADULT RATS IRRADIATED AND STIMULATED WITH TESTOSTERONE. E. Brizzi and G. Giannardi (Istituto di Anatomia Umana Normale dell'Università, Florence). Boll. Soc. Ital. Biol. Sper., 37: 607-9(July 15, 1961).

Eight-month-old rats were irradiated with 1000 r in the suprapubic region and injected intramuscularly 1 hr later with 10 mg testosterone propionate. Histologic changes in seminal vesicle were studied 7 and 15 days later. At 7 days the vesicles of irradiated uninjected rats showed very little cellular modification, except for a few pyknotic nuclei in epithelial and stromal cells. After 15 days the changes were more severe and included separation of epithelial cells from their underlying basement membrane and desquamation and degeneration of these cells. Other cells were relatively normal. In rats treated with testosterone, causing epithelial hyperplasia, the radiation-induced injury to epithelial cells was more severe 7 days after irradiation, but after 15 days, testosterone appeared to have stimulated recovery of the epithelium and a more normal vesicular structure was evident. (H.H.D.)

2839 CHANGES IN THE ULTRASTRUCTURE OF THE THYMUS OF PANIRRADIATED RATS. G. C. Balboni and R. De Dominicis (Università, Florence). Boll. Soc. Ital. Biol. Sper., 37: 611-14(July 15, 1961).

Electron microscopic studies were conducted on the thymus of rats 2 hr after exposure to 100-rad Co^{60} whole-body irradiation. Light microscopy of irradiated thymus showed regressive changes in nuclei and cytoplasm of epithelial cells by this time but no macrophages around degenerating cells. Electron microscopy of thymocytes showed deformation of the nuclear membrane, which in some places became crinkled and double-layered. This was taken as evidence of incipient karyolysis. Chromatin became condensed around the periphery of the nucleus. In the cytoplasm, mitochondria showed vacuolation, with transformation into large vacuoles up to 1 μ in diameter, and decreased electron density. Ribonucleoprotein granules became more sparse and less dense. Changes in reticular cells resembled those described above in thymocytes, and some reticular cells contained dense bodies 1 to 2 μ diameter which may represent phagocytized pyknotic nuclei of degenerating thymocytes. (H.H.D.)

2840 GROWTH RESPONSES OF HELIANTHUS ANNUUS TO INTERNAL CALCIUM-45. Gayther L. Plummer (Univ. of Georgia, Athens). Botan. Gaz., 123: 272-8(June 1962).

Solutions of either $Ca^{45}Cl_2$, stable $CaCl_2$, or deionized water alone were delivered through hypodermic needles inserted into the stems of young sunflower plants (Helianthus annuus L.). In all, 160 μc were delivered to each treated plant by needle and 99 μc were available from the soil. The second and third internodes of the plants treated with this beta-emitting isotope were shorter than those of the two control groups. The apparent effects of radiation were overcome with age, particularly when the treatment was reduced in intensity near the end of the experiment. The radioactive plants were the tallest at the time of flowering. The radioisotope was abundant in parenchymatous tissues and especially abundant in epidermal hairs. The results confirm some early suggestions that internal irradiations may cause reductions in plant growth. This is probably the first controlled experiment, however, in which plant height was shown to be significantly changed by an internal radionuclide. (auth)

2841 PROTECTIVE EFFECT OF TETRAHYDROXYQUINONE AGAINST THE ACTION OF X-RAYS ON BAKERS YEAST. Jean-Louis Séris and André Bru (Faculté des Sciences, Toulouse). Compt. Rend., 255: 791-3(July 1962). (In French)

Tetrahydroxyquinone (THQ) efficiently protects yeast cells against x rays. The optimum protection is found in the pH zone between 4 and 6. For concentrations higher than 5mM/l the percentage of survivals does not vary with increased THQ. (tr-auth)

2842 USE AND ABUSE OF X RAYS IN DERMATOLOGY. Jorge Peniche (Hospital General, Mexico City). Dermatologia (Mex.), 4: 128-30(June 1962).

Misuse of x irradiation in the treatment of acne, dermatitis, and hypertricosis is discussed. (H.H.D.)

2843 EXPERIMENTAL ECZEMA. 12. EFFECTS OF X RAYS IN EXPERIMENTAL ECZEMA (COMBINED INJURY). R. Adatto (Clinique Universitaire de Dermatologie, Geneva). Dermatologica, 122: 201-5(1961). (In French)

Contact dermatitis was induced in guinea pig nipples by local application of 2,4-dinitrochlorobenzene after previous sensitization. No effect of x irradiation on the histologic aspects of the developing dermatitis could be detected when doses of 800 or 1600 r were given 2 to 16 days after sensitization or repeated 100-r doses were given. Although a 800-r dose had no detectable effect on epithelium, it was found to alter the eczematous reaction when given 72 hr before the eliciting application of dinitrochlorobenzene in sensitized animals. Eczematous epithelium in irradiated skin showed swelling of cells, indistinct cell boundaries, diminished numbers of nuclei, and fewer mitoses blocked by colchicine; none of these changes was produced by eczema alone. The changes in epidermis induced by irradiation with 800 r before eliciting eczema resembled those produced by much higher x-ray doses (2400 r), indicating that eczema augments the cellular changes induced by irradiation. (H.H.D.)

2844 THE FREQUENCY OF LYMPHOSARCOMAS IN MICE SUBJECTED TO A SINGLE DOSE AND TO A FRACTIONATED DOSE ON IRRADIATION. S. N. Aleksandrov and K. F. Galkovskaya (Central Research Inst. of Medicinal Radiology, USSR). Dokl. Akad. Nauk SSSR, 146: 1189-92(Oct. 11, 1962). (In Russian)

The mice in group I were given a single, whole-body dose of 800 r from a Co^{60} source. The mice in group II were given four doses of 200 r each at intervals of 7 days, and mice in group III were given four doses of 200 r each at intervals of 30 days. After death the mice were subjected to autopsy, and various organs were removed in order to determine the occurrence of neoplastic growths by cytological methods. The results were corrected for the length of survival, and for the minimum and maximum values of the latent period for the appearance of a cancer. No lymphosarcomas of the carotid gland could be found in the controls. All the growths in the irradiated animals were lymphosarcomas of the carotid gland (with the exception of one case). With the irradiation of male mice, the frequency of lymphosarcomas was a maximum for a single, whole-body dose, and was zero for the irradiations with a 30 day interval between doses. With the irradiation of female mice, the frequency of lymphosarcomas was a minimum for a single, whole-body dose of 800, and increased to a maximum with a fractionated dose at 30 day intervals. Thus, male hormones slow down the formation of lymphosarcomas, and female hormones or estrogens stimulate their formation. (TTT)

2845 INVESTIGATION OF THE DOSE DISTRIBUTION IN THE IRRADIATION OF CERVICAL CARCINOMA. R. Frischkorn (Universitäts-Frauenheilk Göttingen, Ger.). Geburtsh. Frauenheilk., 22: 1111-15(Oct. 1962).

Advantages of Ra implantation over percutaneous x irradiation in the treatment of cervical carcinoma are discussed. By a Ra technique employing 90 mg Ra (6000 mg-hr) and cylindrical filters it was possible to deliver ~30,000 r to the primary tumor. Radiation doses to the ureters,

urinary bladder, rectum, and adjacent structures were determined under various conditions. (H.H.D.)

2846 THE USE OF SUPERVOLTAGE RADIATION IN GYNECOLOGIC RADIATION THERAPY, WITH SPECIAL CONSIDERATION OF SPATIAL AND TEMPORAL DOSE DISTRIBUTION. F. Oberheuser (Universitäts-Frauenklinik Hamburg-Eppendorf, Ger.). Geburtsh. Frauenheilk., 22: 1123-6(Oct. 1962).

The relative advantages and dose distribution with 15-Mev betatron and Co^{60} gammatron irradiation therapy are discussed. (H.H.D.)

2847 PARADOXICAL POTENTIATION OF RADIOINACTIVATION OF SULFHYDRYL ENZYMES BY CATALASE. H. Aebi and A. Temperli (Medizinisch-chemisches Institut der Universitat, Bern). Helv. Physiol. Pharmacol. Acta, 19: C48-50(Dec. 1961). (In German)

Catalase was previously shown to inhibit the radiation-induced suppression of glycolysis in ascites tumor cells and the suppression of methemoglobin formation in irradiated erythrocytes. However, in experiments with liver alcohol dehydrogenase, catalase showed an opposite effect, i.e., it promoted radioinactivation. Addition of 10 μg liver catalase per ml to a solution of 80 μg/ml liver alcohol dehydrogenase reduced the activity of the latter enzyme to 22% of normal after irradiation with 5000 r, compared with 36% in the absence of catalase. Addition of heat-inactivated catalase or serum albumin did not inhibit the radiation-induced reduction in activity. Similar results were obtained with another sulfhydryl-dependent enzyme, lactic dehydrogenase. Whereas catalase may promote the destruction of H_2O_2 formed during irradiation from OH radicals, it may also promote the oxidation of enzyme sulfhydryl groups by the irradiation products. (H.H.D.)

2848 STUDIES ON THE MECHANISMS OF PRODUCTION OF FIBRINOID LESIONS BY X-RAY AND GRAM-NEGATIVE ENDOTOXIN. Wayne H. Schrader, Bruce W. Jarvis, and Joel G. Brunson (Univ. of Minnesota, Minneapolis). Lab. Invest., 8: 996-1005(Sept.-Oct. 1959).

Serial fibrinogen levels were determined in rabbits following various doses of abdominal x-ray, alone and in conjunction with intravenous injections of Gram-negative endotoxin. The changes in this protein were correlated morphologically with the development of diffuse vascular fibrinoid lesions. No heparin-precipitable fibrogen (HPF) was demonstrated following abdominal x ray, but the prevention of development of the lesions by the administration of heparin at the time of administration of endotoxin suggests that similar mechanisms operate in the production of x-ray endotoxin lesions and in those of the generalized Shwartzman phenomenon. (auth)

2849 NUCLEAR REACTOR ACCIDENTS AND THE THYROID. Anonymous. Lancet, 1: 523(Mar. 10, 1962).

After a consideration of the reactor accident at the Windscale No. 1 pile in 1957 (cf. ibid., 2: 1000(1957)), actions required to safeguard the public under such circumstances are proposed. The first danger which must be averted is that resulting from the inhalation of radioactive materials by persons living downwind of the reactor at the time. The accident at Windscale resulted in a release of radioiodine in a far greater proportion than that corresponding to its concentration in normal fission products. This corresponds to the volatility of I relative to other fission products, notably Sr. The Medical Research Council has recommended that the dose to the thyroid from the absorption of radioiodine under accidental conditions should not exceed 25 rem. Administration of KI to those people whom it would be necessary to evacuate might be a simple and safe means of reducing irradiation of the thyroid. If this were done as an alerting action, the need for evacuation might be reduced or eliminated. There are theoretical grounds for believing that a dose of inorganic iodide of 100 mg would reduce the radiation dose to thyroid by a factor of about 10. In addition Pochin and Burnaby (Health Physics, 7: 125(1962)) show that doses of KI containing 200 mg iodide inhibit further thyroid uptake of I^{132} when the iodide is given several hours after single oral doses of radioiodine. Thus irradiation of thyroid could be appreciably reduced if stable KI were administered as long as 3 to 5 hr after absorption of radioiodine. It is concluded that administration of small doses of KI as early as possible after an accidental release of fresh fission products would give a considerable degree of protection to persons living in a region downwind from a nuclear reactor. In this way sudden evacuation which might later prove to be unnecessary would be avoided, and valuable time would be gained during which preparation could be made for orderly evacuation. (H.H.D.)

2850 CHRONIC OCCUPATIONAL EXPOSURE TO STRONTIUM-90 AND RADIUM-226. Jan. Mueller (Charles Univ., Prague and Inst. of Industrial Hygiene and Occupational Diseases, Prague), Alois David, Marie Rejskova, and Dagmar Brezikova. Lancet, 129-131(July 15, 1961).

Results are reported from the follow-up of 103 workers in the luminising industry, who, for different periods, used a paint containing up to 1.2 mc of strontium-90 per gram as well as small amounts of radium-226. Out of this group 34 workers were selected for more detailed inpatient investigations. In most cases only the latter part of the urinary Sr^{90}-excretion curve could be followed. In one case of new contamination the urinary Sr^{90}-excretion curve fitted the equation: $E = 0.376 \exp(-0.693t/1.7) + 0.119 \exp(-0.693t/4.4) + 0.004 \exp(-0.693t/50)$ where exp = exponential function, t = time, and E = the total daily excretion t days after ingestion. The body burden of Sr^{90} was estimated to be of the order of tens of microcuries. The body burden of radium-226 was about 10^{-9} g or less. Hematological studies revealed signs of irritation of erythropoiesis, such as reticulocytosis and hyperplasia of the erythroblast series in the bone-marrow. (auth)

2851 THE RATE OF PULSE-WAVE PROPAGATION AS A METHOD FOR ASSESSING THE FUNCTIONAL STATE OF THE CARDIOVASCULAR SYSTEM IN PERSONS EXPOSED TO CHRONIC IRRADIATION. E. A. Denisova (Inst. of Labor, Health, and Occupational Disease, Academy of Medical Sciences, USSR). Med. Radiol., 10: No. 10, 28-32 (Oct. 1962). (In Russian)

The rate of pulse-wave propagation in vessels of elastic and muscular types was determined. The final results indicated changed vascular tone, manifesting itself in variations in the level of arterial pressure, pulse rate, and also in increased rate of pulse wave propagation at early periods of radiation exposure and in its deceleration at later dates and with high doses of irradiation, the alterations occurring earlier in vessels of the muscular type. Relationship between the pulse wave propagation rate and the level of arterial pressure was also noted. (auth)

2852 FLUORESCENT-MICROSCOPIC EXAMINATION AS A METHOD FOR DETECTING EARLY ALTERATIONS IN THE PERIPHERAL BLOOD FOLLOWING THE EFFECT OF LOW IONIZING RADIATION DOSES USED IN CLINICAL PRACTICE. L. A. Leshchinskii, V. V. Trusov, and E. V. Lavrentev (Izhevsk Medical Inst., USSR). Med. Radiol., 10: No. 10, 32-5(Oct. 1962). (In Russian)

The method of fluorescent-cytological examination was used in order to detect early alterations occurring in trace elements of the white blood in the course of patients: treatment with radioactive substances (I^{131} in thyrotoxicosis,

P^{32} – in chronic leukemia and erythremia, artificial radon baths), as well as when employing isotopes for diagnostic purposes. To identify nucleic compounds in leukocytes, the blood was treated with fluorescent stain solutions (most often with acridine orange) during examination. In healthy persons the number of leukocytes with altered nuclear chimism varied from 2 to 6 per every 100 (2–6%) and their nucleus then showed red. Following curative use of I^{131} and also in radiotherapy cytochemical shifts, reflected in the fluorescent picture of the blood, are recorded. In many patients the changes were of an undulating nature and by the degree of their intensity differ from one person to another. The tracer doses of I^{131} were also liable to cause changes in the nucleinic metabolism of white blood cells. These, being very accurately recorded by the fluorescent-microscopic method, were of a reversible nature and pursued a subclinical course. The method was extremely sensitive and enabled a clear-cut account of early changes in the blood occurring under the effect of ionizing radiation not recognizable by means of an ordinary morphological investigation. (auth)

2853 CHANGES IN THE MORPHOLOGICAL COMPOSITION OF PERIPHERAL BLOOD IN CHILDREN SUBJECTED TO ROENTGENOLOGICAL EPILATION FOR FUNGUS DISEASES OF THE SCALP. I. I. Pilger and E. G. Dolgov (Semipalatinsk Medical Inst., USSR). Med. Radiol., 10: No. 10, 35-8(Oct. 1962). (In Russian)

A long-term follow-up observation covered the state of peripheral blood in 15 children subjected to roentgenological irradiation in connection with diseases of the scalp. The roentgen-epilation was shown to be accompanied with considerable derangements in the morphological composition of the blood, which was observable for a period of 100 days after irradiation. (auth)

2854 CHANGES IN THE IMMUNOLOGICAL REACTIVITY AND MORPHOLOGICAL RECONSTRUCTION OF THE LYMPHOID TISSUE AT DIFFERENT STAGES OF RADIATION INJURY. A. I. Polyak (Rostov Medical Inst., USSR). Med. Radiol., 10: No. 10, 51-5(Oct. 1962). (In Russian)

Immunological reactivity of the lymphoid tissue was studied at various phases of radiation injury. With a view to following up changes occurring in the antibody-forming tissue — cells taken from a lymphoid node of a rabbit, immunized at various periods prior to and after whole-body irradiation, were transplanted into the anterior chamber of an intact animal. This revealed a noticeable derangement of the antibodies formation on the level of radiation injury and a very slow restoration of this function in the convalescent period. This was attributed to a disturbed reception of the antigenic stimulus, due to penetrating radiation. (auth)

2855 THE INFLUENCE OF COAMIDE ON THE HEALING OF CLOSED FRACTURES IN IRRADIATED ANIMALS. F. Kh. Seifullin (Inst. of Roentgenology, Radiology and Oncology, Ministry of Public Health, Uzbek, SSR). Med. Radiol., 10: No. 10, 55-9(Oct. 1962). (In Russian)

The therapeutic effect of coamide (a complex compound of cobalt with nicotinic acid amide) on the healing of closed fractures in tubular bones of rabbits, irradiated with a dose of 800 r, was studied. Subject to experimentation were 50 rabbits. The healing of the bones was studied both clinically and roentgenologically. Observations demonstrated the use of coamide to appreciably accelerate the appearance and formation of the callus in irradiated animals. (auth)

2856 THE EFFECT OF IONIZING RADIATION ON THE CONTENT OF READILY DETACHABLE FERUM IN THE BLOOD SERUM. G. N. Elpatevskaya. Med. Radiol., 10: No. 10, 67-8(Oct. 1962). (In Russian)

Studies were made of readily detachable iron in blood serum from 475 men and 568 women exposed to small doses of ionizing radiation. Following a single exposure the level of detachable iron in the largest group (86%) was reduced (50 to 15γ%). A normal content of readily detachable iron (60 to 120γ%) was observed in 14%, a reduced content (35 to 50γ%) in 68%, and a low content (15 to 25γ%) in 18% of the cases. A general disturbance in other types of exchange was also observed. The content of albumin increased (8.8 to 9.8%) in the blood serum of 30% and reduced in 6% of the cases. The changes in the readily detachable iron in the blood serum and in peripheral blood in persons exposed to continuous small doses are of a phase character and in most cases are reversible. (R.V.J.)

2857 THE INFLUENCE EXERTED BY ROENTGENOLOGICAL RADIATION ON THE COURSE OF THE VACCINATION PROCESS AND THE IMMUNITY INTENSITY RATE FOLLOWING VACCINATION AGAINST TULAREMIA. R. A. Savel'eva. Med. Radiol., 10: No. 10, 68-9(Oct. 1962). (In Russian)

Studies were made of 90 vaccinated guinea pigs weighing 300 to 400 g and exposed to 200 r. The obtained data showed that irradiation depressed the immunogenic resistance to tularemia and, in cases of simultaneous vaccination and exposure, depressed the development of immunity. (R.V.J.)

2858 PROPHYLAXIS OF RADIATION INJURIES WITH THE AID OF SULFUR-CONTAINING COMPOUNDS. A. P. Kiryushchenko. Med. Radiol., 10: No. 10, 77-85(Oct. 1962). (In Russian)

A review is given on prophylactic measures against radiation injuries using sulfur compounds. The mechanism of sulfur compound radiation protection was analyzed. The theory of radiolysis product inactivation, reactivation of thiol enzymes, disulfide protection of albumen, effects of sulfur substances on metabolism in irradiated tissues and organs, and tissue hypoxia are discussed. (R.V.J.)

2859 BIOLOGICAL AND PHYSICAL RANGES OF PHOTOPROTECTION FROM ULTRAVIOLET DAMAGE IN MICROORGANISMS. J. Jagger and R. S. Stafford (Oak Ridge National Lab., Tenn.). Photochem. Photobiol., 1: 245-57(1962).

Photoprotection from biological damage by ultraviolet radiation of 2537 A has been sought in a variety of microorganisms. Its taxonomic occurrence is spotty and it is clearly not as general a phenomenon as photoreactivation. The action spectrum has been determined for bacteria from two different taxonomic orders and found to be the same, lying in the range 3100 to 4000 A, with a single peak at 3400 A. These spectra are much narrower than those for photoreactivation and are confined to the near ultraviolet region. Their similarity suggests that only one chromophore is utilized in bacterial photoprotection. Photoprotection is found to require, at an ultraviolet survival level of 2%, about three times as much radiation energy as photoreactivation. Consideration of absorption and action spectra, as well as a direct test with transforming principle, indicates that the chromophore probably is not nucleic acid. The action spectra suggest reduced diphosphopyridine nucleotide. (auth)

2860 ON THE ABSORBED DOSES OF SOME ORGANS OF NEUTRON EXPOSED SMALL ANIMAL. Osamu Yamamoto and Shozo Sawada (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 3, 35-7(1962). (In Japanese)

Determination of the C, N, H, and O content of the soft tissues, such as bone marrow, kidney, liver, spleen, muscle, intestines, and body fat was carried out. The absorption of 14.1-Mev neutrons in these tissues was measured. The calculations did not indicate any difference in the ab-

sorbed dose which led to the conclusion that the injury of the bone marrow is of the same order of magnitude as injury to other soft tissues. (TTT)

2861 THYROID DISEASES AMONG A-BOMB SURVIVORS. A STATISTICAL STUDY. Kiyoshi Shimizu, Mineo Watanabe, and Sadato Ito (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 3, 55-9(1962). (In Japanese)

A total of 2453 patients, residents of Hiroshima, was examined; 49 of them had thyroid disease. 35 individuals of this group had benign tumors of the thyroid; the average age of this group was 46.8 years. Fourteen patients with an average age of 45.3 years had carcinoma of the thyroid. The appearance of the benign tumors occurred in average 11.2 years after the Hiroshima A-bomb, while the carcinomas of the thyroid were noted in average 10.4 years after the explosion. (TTT)

2862 RADIATION AND CYSTEINE EFFECTS ON LIVER CELL DIELECTRIC STRUCTURE. K. S. Trincher and A. A. Mikhailova (Inst. of Biological Physics, Moscow). Radiobiologiya, 2: 523-9(1962). (In Russian)

The dielectric structure of liver cells (simulated by a dipole model) was analyzed. In the absence of an electric field the dipole molecules fill the intracellular space and are found in electric equilibrium with neutral charges. In the presence of electric field the volume charges appear in all cellular spaces due to dipole molecule rotation. The radioinduced destruction of dipole molecules and the release of fixed electric charges result in degradation of liver cells. Treatments with cysteine improve the dielectric properties and strengthen the cell structure by partially immobilizing dipole molecules. (R.V.J.)

2863 EFFECTS OF IONIZING RADIATION ON THE HIGH-POLYMER RIBONUCLEIC ACID IN EHRLICH ASCITIC TUMOR CELLS. L. S. Mil'man and I. M. Shapiro (Severtsov Inst. of Animal Morphology, Moscow). Radiobiologiya, 2: 530-2(1962). (In Russian)

An exposure of Ehrlich tumor cells to 3000 r of x radiation failed to produce any disturbance in the high-polymer RNA cytoplasm macro-molecular structure. (R.V.J)

2864 EFFECTS OF CERTAIN MONOMERS ON BIOLOGICAL FUNCTIONS OF IRRADIATED YEAST CELLS. Yu. P. Kozlov, A. I. Gorin, and F. Barnetskii. Radiobiologiya, 2: 539-42(1962). (In Russian)

Protective effects of various aqueous monomer solutions (vinyl pyrrolidone, acrylonitrile, and acrylamidine) in various concentrations on the survival of irradiated yeast cells were analyzed. (R.V.J.)

2865 EFFECTS OF LETHAL RADIATION DOSES ON CATALASE ACTIVITY IN BLOOD. L. I. Tiunov, G. A. Vasil'ev, and O. I. Smirnova. Radiobiologiya, 2: 548-52 (1962). (In Russian)

The catalase activity in leukocytes and erythrocytes was studied during acute radiation sickness in dogs. A drop in the catalase index was observed 5 min after exposure to 600 to 650 r; the drop continued during the next 20 to 30 min. The maximum drop in enzyme activity was observed during the terminal stages when the catalase activity was about one-third normal. (R.V.J.)

2866 HISTOCHEMICAL STUDIES OF IONIZING RADIATION EFFECTS ON NUCLEIC ACID AND GLYCOGEN DYNAMICS IN RAT LIVERS. G. D. Gubin (Sverdlovsk Medical Inst., USSR). Radiobiologiya, 2: 553-7(1962). (In Russian)

Histochemical studies were made of 73 control and 107 white rats exposed to 800 r in 1 hour. The results showed a considerable depletion of DNA in liver cell nuclei at very early stages of exposure. A simultaneous increase in RNA concentration with depletion of glycogen was observed 24 hours following exposure. (R.V.J.)

2867 EFFECTS OF IONIZING RADIATION ON SUGAR AND LACTIC ACID DYNAMICS. V. A. Kostromskaya (Sverdlovsk Medical Inst., USSR). Radiobiologiya, 2: 558-60(1962). (In Russian)

Alterations in hydrocarbon metabolism by liver begin on the second day after exposure. Concentrations of lactic acid are higher on the second day (28%) and lower on the third day (32%). Changes in sugar content were not determined. (R.V.J.)

2868 EFFECTS OF IRRADIATED THYROID GLAND ON THE CEREBRAL CORTEX. I. N. Kondrat'eva. Radiobiologiya, 2: 569-72(1962). (In Russian)

An increased level of bioelectric activity and rapid cardiovascular constriction were observed 2 to 3 hours after irradiation of intact thyroid glands. The reaction is weakened or eliminated in animals with denervated glands. The experiments indicate that peripheral nervous system pulsation plays an important part in cerebral cortex activation and heart reaction in the first hours after exposure. (R.V.J.)

2869 VARIATIONS IN MYOTACTIC REFLEXES IN X-IRRADIATED RABBITS. Z. M. Gvozdikova. Radiobiologiya, 2: 573-9(1962). (In Russian)

Depression of myotactic m. femoralis reflex in decerebrated rabbit preparations was observed in rabbits two days after exposure to 800 to 1000 r. Depressed m. femoralis responses are expressed by reduced amplitudes and reduced reflex time. (R.V.J.)

2870 IMMUNOLOGICAL PROPERTIES OF DENATURALIZED BLOOD ALBUMIN SERUM IN RABBITS EXPOSED TO IONIZING RADIATION. L. G. Prokopenko. Radiobiologiya, 2: 580-5(1962). (In Russian)

Changes in immunological specificity of blood albumin and γ-globulin synthesized in irradiated organisms were studied using homo-immunization methods. It is shown that a measured thermodenaturization of albumin and γ-globulin mixture formed an albumin complex that possesses special antigenic properties. The albumin–γ-globulin complex is unstable. The antigen albumin and γ-globulin structures were disturbed by infectious hyperthymia that appeared on the 10th day following exposure. (R.V.J.)

2871 ANTIGENIC STRUCTURE OF GLOBULIN FRACTION MADE FROM PERFUSE TISSUES FROM IRRADIATED DOG. G. M. L'vitsina and Yu. D. Balin. Radiobiologiya, 2: 590-4(1962). (In Russian)

Test data on desensitization anaphylotis in guinea pigs showed decreased antigen complexes in γ-globulin from perfuse tissues from irradiated dogs. Immunization of healthy dogs by homologous γ-globulin from irradiated dog perfuse tissues also indicated antigenic changes. (R.V.J.)

2872 EFFECTS OF Sr^{90} ON MORPHOLOGICAL CHANGES IN OVARIES AND DISTURBANCES IN WHITE RAT REPRODUCTION. T. V. Vorozheikina. Radiobiologiya, 2: 601-6(1962). (In Russian)

A single intraperitoneal injection of 0.4 μC/g of Sr^{90} induced morphological changes in white rat ovaries. Functional alterations were obvious during the first 2 months following exposure. Morphological changes expressed by ovary cell destruction, increased follicular dimensions, reduced yellow bodies, and enlarged ovary connective tissues were observed during the 7th to 8th month after injection. Gonad functional changes appear before the morphological changes. (R.V.J.)

2873 PROTECTIVE EFFECTS OF PHENATINE AND MERCAMINE ON THE DEVELOPMENT OF SCLERAL PA-

PILLA IN CHICKEN EMBRYO. V. F. Puchkov (Leningrad Inst. of Experimental Medicine). Radiobiologiya, 2: 611-15(1962). (In Russian)

The exposure of a chicken embryo to 400 r of x radiation on the sixth day of incubation depressed the development (50%) of eye scleral papilla; an exposure to 600 r completely eliminated the scleral papilla. An injection of 4 mg of phenatine into the yoke of six-day embryo also depressed the development of scleral papilla. Introduction of phenatine (0.5 mg) and mercamine (0.5 mg) per yoke before exposure to 400 r increased the number of developing papillae by 20 to 29%. (R.V.J.)

2874 ON THE RECOVERY FROM MITOTIC INHIBITION DUE TO IRRADIATION. EXPERIMENTAL STUDIES ON REGENERATING LIVER IN RATS. M. Laddaga and U. Romagnoli (Università, Pisa, Italy). Radiol. med., 48: 777-93(Aug. 1962). (In Italian)

It was observed that localized irradiation of the regenerating liver in rats, 2000 r, immediately before partial hepatectomy, inhibits karyokinesis of the parenchymal cells for the next 48 hours. By provoking regeneration at various intervals (up to 256 days) after irradiation, it was demonstrated that the mitotic inhibition persists for a long time. Nevertheless, the mitotic block gradually tends to lessen as the interval between irradiation and hepatectomy increases. This effect can be considered the expression of damage to the hepatocyte, probably involving its nucleus. It has a particular latency which is interrupted only when the cell is stimulated to divide. Moreover, it is reversible in character, and its behavior appears to be linked to the phenomenon of cell recovery. (auth)

2875 MEDICAL USES OF Ca^{47}. Technical Reports Series No. 10. (International Atomic Energy Agency, Vienna). 1962. 128p. (STI/DOC/10/10). $1.00(IAEA).

A summary is presented of the proceedings of a panel discussion on the medical uses of Ca^{47} held in Vienna from Dec. 6 to 8, 1961. Principal investigators from 8 countries participated. The subject matter was not narrowly restricted to Ca^{47}, but in addition included analytical techniques appropriate to alternative Ca and Sr tracers, and medical problems to which these tracers are applied. Data on the availability and sources of Ca^{42}, Ca^{45}, Ca^{44}, Ca^{45}, Ca^{46}, Ca^{47}, and Ca^{48} are appended. (C.H.)

2876 EFFECT OF TOTAL BODY X-IRRADIATION ON VIABILITY OF METASTATIC TUMOR CELLS. Horace Goldie, Gadson J. Tarleton, Lonnie Deaderick, and Odis Strong (Meharry Medical Coll., Nashville). 2p. (TID-17116)

To be published in the Proceedings of the 44th Annual Meeting of the Federation of American Societies for Experimental Biology, April 11-17, 1960.

Mice were inoculated intraperitoneally with doses of 40 millions of ascitic tumor cells. Three days later the mice were x irradiated with doses of 200, 400, or 600 r. Twenty-four hr later all animals were sacrificed and pooled blood from the animals injected into new mice. Viable tumor cells were detected in an average of 95% of untreated controls to all groups, in an average of 80% of the mice irradiated with 200 r, in 70% of those irradiated with 400 r, and in 10% of those irradiated with 600 r. Results show that high doses of x radiation inhibited viability in a considerable proportion of tumor cells circulating in the blood even when the primary growth was abundant. Similar results were obtained in mice injected with cells of malignant lymphoma with the exception that the lymphatic tumors were more radiosensitive. (C.H.)

Radiation Sickness

2877 (TID-14791) BIOLOGICAL RECOVERY FROM RADIATION INJURY. J. F. Spalding (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 10p. (LADC-5207)

Factors influencing biological recovery from radiation injury are discussed. Mathematical parameters are given for use in calculating total injury, based on approximate estimates of the percent of irreparable damage resulting from exposure to x and γ radiations and fission neutrons of various doses for acute and constant exposure. Data are tabulated on equivalent acute and accumulated doses. Applications in calculating the radiation dose to exposed populations are discussed. (C.H.)

2878 RADIATION INJURY: BONE MARROW TRANSPLANTATION. C. C. Congdon (Oak Ridge National Lab., Tenn.). Ann. Rev. Med., 13: 203-12(1962).

A review is given of developments in studies on bone marrow transplantation in experimental animals and man for the last ten years. Discussion is given on systems for identifying foreign bone marrow transplants, foreign bone marrow reaction (secondary disease), physiological aspects of blood formation, major variables in bone marrow transplantation, and experiments with large animals and man. (P.C.H.)

2879 SEROTONIN AND THE LOCAL EFFECT OF X RAYS: EXPERIMENTS IN THE SKIN OF GUINEA PIGS. A. Maggiora (Clinique Universitaire de Dermatologie, Geneva). Dermatologica, 122: 200(1961). (In French)

Serotonin (5-hydroxytryptamine) was found to have a protective effect against x irradiation when given to guinea pigs 5 min before exposure. This was demonstrated by means of a previously described method, which involves changes in the mitotic rate in the nipples of estrogen-treated male animals induced by epilating radiation doses. (H.H.D.)

2880 THE PROTECTIVE ACTION OF PHYTOLIPOPOLYSACCHARIDES AND OF VB-2 DURING IRRADIATION. V. A. Sondak, E. P. Gracheva, B. N. Gladyshev, and V. I. Suslikov (Inst. of Biological Physics, and Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 146: 925-8(Oct. 1, 1962). (In Russian)

White rats were given a single, whole-body dose of 700 r from a Co^{60} source. The rats in group I were each given a total of 200 to 400 γ of a preparation of tea leaves containing phytolipopolysaccharides. The protective agent was administered subcutaneously in four injections at 96, 72, 48, and 24 hours before irradiation. The rats of group II were given an additional, oral preparation of vinylbutyl ether polymer (mol. wt. = 6000) 24 hours after irradiation, and daily thereafter for 30 days. The animals in group III served as controls. Erythrocytes, leucocytes, the leucocytic formula, reticulocytes, trombocytes, and the hemoglobin content were determined before irradiation, and on the 1st, 5th, 10th, 15th, 20th, and 30th day after irradiation. The death rates in groups I and II were 26 and 23% as compared to a death rate of 62% in the controls of group III. The blood picture was much better in the animals of group I and II than in the controls. The controls showed a low of 47% hemoglobin content compared to 95 to 100% of the initial hemoglobin content in groups I and II. The increase in erythrocyte count was more rapid in the animals of group I and II than in the controls. Thus, it is shown that a preparation of lipopolysaccharides from tea leaves possesses a protective action against irradiation. (TTT)

2881 RADIATION INJURY OR RADIATION SIDE-EFFECTS? A. Rummel (Universitäts-Frauenklinik Würzburg, Ger.). Geburtsh. Frauenheilk., 22: 1131-2(Oct. 1962).

It is proposed that the term "radiation side-effects" should be used rather than "radiation injury" in reference to the sequelae of radiotherapy. (H.H.D.)

2882 ON THE ASSESSMENT OF BENGAL-ROSE — A NEW HOME-MADE PREPARATION. V. V. Sedov, G. F. Nevskaya, N. I. Ovdienko, and Yu. B. Mandel'tsveig. Med. Radiol., 10: No. 10, 15-21(Oct. 1962). (In Russian)

A new home-made preparation Bengal Rose (tetra-iodine-dichlorofluoresceine, labeled with I^{131}) was tested. The preparation comprised 0.5 μC per mg of stain. In preliminary experiments on rats, evidence that the preparation becomes amassed prevalently in the liver was obtained. Further, the junction of this organ was investigated in major laboratory animals (25 rabbits and 30 dogs). It appeared that in normal conditions liver radioactivity curves in different animals were of analogous shape, but there were distinctions among various species in the liver accumulation and excretion rates of the Bengal-Rose. In acute and chronic radiation sickness the outline of the liver radioactivity curves differs. By the variation occurring in the shape of the radioactivity curves, the degree marking the disturbance of the liver function can be made. (auth)

2883 DETERMINATION OF CIRCULATION PERIODS FOR TRANSFUSED Cr^{51} LABELLED THROMBOCYTES IN ACUTE RADIATION SICKNESS. M. G. Shitikova and G. I. Kozinets (Lenin Inst. of Hematology and Blood Transfusion, USSR). Med. Radiol., 10: No. 10, 41-4(Oct. 1962). (In Russian)

The duration of circulation for transfused thrombocytes labeled with Cr^{51}, in dogs under normal conditions and immediately after irradiation, was studied. With the thrombocytes introduced on the 2nd–3rd and 9th–10th days following irradiation, the circulation time of the plaques was reduced to 3–4 and 2–3 days, respectively, as against $^5/_8$ days in normal conditions. In acute radiation sickness, thrombocyte transfusion is recommended every 2–3 days. (auth)

2884 AUTOTRANSPLANTATION OF BONE MARROW CELLS IN THE TREATMENT OF RADIATION SICKNESS INDUCED IN RATS BY FRACTIONAL IRRADIATION. G. S. Strelin and N. K. Shmidt (Inst. of Medical Radiology, Ministry of Public Health, USSR). Med. Radiol., 10: No. 10, 44-51(Oct. 1962). (In Russian)

Experiments on rats showed very high efficacy of the radiation sickness treatment by means of bone marrow cells autografting. The cells were taken from a bone marrow segment (hip) screened during irradiation. With this procedure the transplantation and distribution of non-irradiated cells, associated with it, yield a much higher effect than letting intact in the body of the screened bone marrow segment, even when the latter contains cells in numbers many times over those utilized for injection. The obtained results may be of importance for the practical treatment of radiation sickness in instances when this arises as a result of partial irradiation and it is possible to make use of the injection bone marrow taken from non-irradiated parts of the body. (auth)

2885 THE USE OF BONE MARROW CELL INJECTIONS IN LETHALLY IRRADIATED MICE. G. E. Cosgrove (Oak Ridge National Lab., Tenn.). Metropolitan Detroit Sci. Rev., 23: 33(1962).

Deaths following external whole-body irradiation in mice (and other mammals) are usually classified into three main types. Those occurring at the lower dose range are largely a consequence of damage to the blood forming tissues, such as bone marrow. Those in mid-range are predominantly due to intestinal damage. The higher doses, 10,000 to 20,000 r and over, cause deaths from central nervous system damage. To date only exposure in the lowest ranges can be effectively treated. Although not discussed here, certain protective chemicals, if present in the mouse at the time of irradiation, can effectively increase radioresistance. Bone marrow cell injection is also very effective in increasing survival rates after lethal irradiation. In the basic technique, several million nucleated bone marrow cells are flushed from the long bones of a donor mouse using physiologic fluid such as Tyrode's solution. A cell suspension is prepared by repeatedly drawing the marrow suspension through a small gauge needle. The suspension is then injected intravenously into the previously irradiated recipient mouse. Recovery for the first 30-day period after irradiation is often dramatic. The cells must not be injected before irradiation or they will be killed or damaged by the irradiation and be useless to the recipient. They may be injected as late as 4 to 7 days after irradiation and still result in better survival. The cells must be alive at the time of injection since the good effect is the result of their transplantation and growth in blood-forming tissues. The injected mouse, then, becomes a chimera, containing two different populations of cells, his own and those derived from proliferation of the donor cells. Usually the content of one femur, tibia, or other long bone contains enough cells to rescue an irradiated recipient. In genetically uniform strains of mice the potential dangers of antigen-antibody reactions between donor and recipient are negligible. However, this uniformity is hard to attain in other species, e.g., in man it would be practical only by using identical twins as donor and recipient. In mice we can produce delayed bone marrow transfusion reactions by using strains of unrelated mice as donors and recipients. Such donors are homologous to the recipients, i.e., being of the same species of animal but not genetically identical. The term isologous is used for donors of the same species and same genetic constitution and the term heterologous when donor and recipient are of different species, e.g., rat and mouse. Bone marrow transfusion reactions often do not show up until the second month after irradiation. In other words, the transfused cells protect the animal from acute radiation lethality for 30 days or more before a delayed immune reaction occurs, which may be lethal. (auth)

2886 DIFFERENCES OF LETHAL EFFECTS BETWEEN NEUTRON AND X-RAY SINGLE EXPOSURE ON MICE. Shozo Sawada (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 3, 31-4(1962). (In Japanese)

The effects of 14.1-Mev neutrons from the T(d,n) reaction (330 to 600 rads) and x radiation (190 to 760 rads) on the survival rate and the weight loss of mice were compared. The largest numbers of deaths occurred about 15 days after the treatment in the x-irradiated group and 10 days after exposure in the neutron-treated group. The body weight of both groups of irradiated mice decreased; the neutron-treated animals showed a more pronounced decrease 5 days after exposure, but a secondary decrease in the body weight of the x-irradiated mice occurred 10 days after the treatment; this secondary weight loss was not noticed in the neutron-treated group. The relative biological effectiveness for neutrons based on LD_{50} for 30 days was 1.0 to 1.5. (TTT)

2887 CHEMICAL PROTECTION AGAINST IONIZING RADIATIONS. REPORT 1. PROTECTIVE EFFECT OF MEG AGAINST X-IRRADIATION MORTALITY OF MICE.

Shigetoshi Antoku (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 3, 45-7(1962). (In Japanese)

Various amounts of MEG_{Br} (mercaptoethylguanidine) and of AET_{Br} (S, β-aminoethylisothiuronium Br, HBr) at neutral pH were administered intraperitoneally to mice (ddc strain) exposed to whole-body irradiation of 800 r of x rays. The most effective doses were 190 mg/kg for MEG_{Br} and 250 mg/kg for AET_{Br}. The MEG_{Br} given 10 minutes prior to the irradiation resulted in greater than 90% survival; the body weight of the irradiated animals remained virtually unchanged. No differences attributable to sex were observed in the animals which received MEG_{Br}. The AET_{Br} was found to be most effective when injected 30 minutes before the start of the irradiation. (TTT)

2888 CHEMICAL PROTECTION AGAINST IONIZING RADIATIONS. REPORT 2. RELATIONSHIP OF IRRADIATION DOSE AND OPTIMUM MEG DOSE. Shigetoshi Antoku (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 3, 49-50(1962). (In Japanese)

The optimum dose of MEG (mercaptoethylguanidine), determined on the basis of the survival ratio, was obtained for 4 levels of whole-body x-irradiation of female mice (ddn strain). The MEG was injected at the neutral pH point intraperitoneally 10 minutes prior to the start of the irradiation. The following optimum doses of MEG were determined: for 1300 r, 400 mg/kg; for 1000 r, 300 mg/kg; for 800 r, 250 mg/kg; and for 600 r, 100 to 200 mg/kg. (TTT)

2889 SELYE ABSCESS PENETRABILITY TO RADIOISOTOPES DURING ACUTE RADIATION SICKNESS. N. P. Ushkov (Khar'kov State Medical Inst.). Radiobiologiya, 2: 533-8(1962). (In Russian)

Depressed uptake of $Na_2HP^{32}O_4$, $Sr^{89}(NO_3)_2$, and colloidal Au^{198} was observed on the 5th, 8th, and 14th day after exposure. Radiation sickness increased the penetrability of the inflamed organs and of various other organs and tissues. The inflamed barrier sensitivity to radioactive isotopes was more pronounced with phosphors than with strontium and gold. (R.V.J.)

2890 DATA ON CATECHOLAMINES AND THEIR OXIDATION IN RADIATION SICKNESS. B. B. Moroz, S. P. Grozdov, and E. N. Petrovnina. Radiobiologiya, 2: 543-7 (1962). (In Russian)

A considerable amount of catecholamine oxidation products, and in some cases adrenaline, were found in the blood of rabbits exposed to 800 r of x radiation. A high concentration of adrenaline was observed in the left ventricle during the first hours after exposure and during the acute period. Intravenous injections of 0.2 mg of adrenaline resulted in a strong increase in oxidation products. Injections of ephedrine did not eliminate adrenaline oxidation in irradiated rabbits, while additions of ascorbic acid restored the oxidation products. The experiments confirmed that catecholamine oxidation follows a chinoidal type oxidation and that the oxidation products are of reverse oxidation-dehydroadrenaline type. (R.V.J.)

2891 AUTOTRANSPLANTATION OF BONE MARROW CELLS IN RADIATION SICKNESS. G. S. Strelin, N. K. Shmidt, and A. K. Ryabukhina (Leningrad Inst. of Medical Radiology). Radiobiologiya, 2: 561-6(1962). (In Russian)

Radiation effects were compared using 170 to 200 g male white rats exposed to total-body irradiation, irradiation with hip screening, and irradiation with hip screening followed by marrow transplantation. The autotransplantation of non-irradiated marrow showed a more positive effect than screening, though the latter resulted in a far larger number of cells. (R.V.J.)

2892 EFFECTS OF CERTAIN RADIO-PROTECTIVE AGENTS ON THE RADIOSENSITIVITY AND THE LEVEL OF OXYGEN IN ANIMAL TISSUES. K. A. Zeitunyan, M. M. Konstantinova, and L. F. Semenov (Inst. of Experimental Pathology and Therapy, Academy of Sciences, USSR). Radiobiologiya, 2: 616-19(1962). (In Russian)

Test data on the oxygen level in liver and spleen tissues of 18 to 20 g white rats injected with 0.02 mg of adrenaline, 0.6 mg of acetylcholine, 1.5 mg of tryptamine, 0.5 mg of serotonin, 0.8 mg of phenethylamine, 45 mg of thiourea, and 3 mg of aminoethylisothiouron (AET) indicated that acetylcholine reduces oxygen intensity in the spleen and liver, while the other chemicals produce hypoxia. Combined applications of acetylcholine with amines reduces the oxygen intensity amplified by the amine. Combined acetylcholine and adrenaline or tryptamine and serotonin induces a strong hypoxia (60 to 70%) and results in the survival of 35 to 70% of rats exposed to lethal doses, while applications of adrenaline, phenethylamine, and tryptamine induced less pronounced hypoxia (15 to 30%) with only 5 to 20% survival. Tiourea does not affect the oxygen level in the spleen but induces a slowly rising hypoxia in the liver. (R.V.J.)

2893 RADIOCESIUM IN PLANTS GROWN ON RONGELAP ATOLL SOILS. R. B. Walker, E. E. Held, and S. P. Gessel (Univ. of Washington, Seattle). p.1363-7 of "Recent Advances in Botany." Toronto, University of Toronto Press, 1961.

Tomato and squash plants were grown in greenhouse pot cultures using soil from Rongelap Atoll, which received fallout contamination in 1954. The treatments involved various combinations of N, P, and K. All fertilizer treatments markedly reduced the content of Cs-137 in the tissue. Also reported are the results of a field experiment on Rongelap Island in which fertilization with KCl at least temporarily reduced the content of Cs-137 in a native grass. Potassium and Cs-137 contents of foliar samples of several woody species collected on Rongelap Island are also included. In the most common pattern, K and Cs-137 contents of the upper foilage were higher than those of the lower leaves, but one species consistently showed higher K but lower Cs-137 in the upper foilage. Low K status of the soil and differences in mobility within the plant may explain these patterns. (auth)

CHEMISTRY

General and Miscellaneous

Refer also to abstracts 2664, 3689, 3690, 3691, 3693, 3694, 3696, 3698, 3699, and 3705.

2894 (AWRE/LIB/BIB/9) URANIUM AND PLUTONIUM OXALATES. W. A. Dowden (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). July 1962. 13p.

A total of 131 references is presented to patents, reports, and published articles on the subject of oxalates of plutonium and uranium. Sources were Nuclear Science Abstracts and Chemical Abstracts for the period 1953–1961. (R.J.S.)

2895 (NYO-9872) VIBRATIONAL SPECTRA AND BONDING IN METAL CARBONYLS. II. INFRARED SPECTRA OF AMINE-SUBSTITUTED GROUP VI CARBONYLS IN THE CO STRETCHING REGION. C. S. Kraihanzel and F. A. Cotton (Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry). Nov. 2, 1962. Contract AT(30-1)-1965. 37p.

A method presented earlier for interpreting the CO stretching frequencies of substituted metal carbonyls of the type $ML_n(CO)_{6-n}$ in terms of CO stretching and stretch-stretch interaction force constants is applied to molecules in which M = Cr, Mo, and W and the L's are supplied by cyclohexylamine, ethylenediamine, diethylene triamine, pyridine and α,α-dipyridyl. The results are discussed in terms of the pi-bonding abilities of these ligands. Several of the compounds studied are new and their preparation and characterization are described in detail. (auth)

2896 KINETICS OF CESIUM REACTIONS WITH SOME INORGANIC CATION EXCHANGE MATERIALS. L. L. Ames, Jr. (General Electric Co., Richland, Wash.). Am. Mineralogist, 47: 1067-78(Sept.-Oct. 1962). (HW-SA-2343)

The kinetics of cesium exchange for sodium were studied in the film diffusion region for several cation exchange materials, including an alumina-silica gel, Type A synthetic zeolite, clinoptilolite, phillipsite, erionite, and vermiculite. Existing techniques, including the "shallow bed" used to investigate cation exchange kinetics of organic resins, were applied to the above inorganic exchange materials. Results for the effects of temperature, flow rate, cesium concentration, and competing sodium on film diffusion loading rates are given, as well as particle diffusion data. Cesium diffusion film thickness was computed by two methods with comparable results. Loading rates of inorganic cation exchangers can be predicted through use of fundamental kinetic data. (auth)

2897 ELECTROCHEMICAL STUDIES ON ERIOCHROME VIOLET B AND ITS LANTHANIDE COMPLEXES. II. CONTROLLED-POTENTIAL COULOMETRIC STUDIES. T. M. Florence (Atomic Energy Commission Research Establishment, Lucas Heights, Australia) and G. H. Alyward. Australian J. Chem., 15: 416-24(Aug. 1962).

Controlled-potential coulometric studies of Eriochrome Violet B (5-sulfo-2-hydroxy-benzeneazo-2-naphthol) using a stirred mercury pool cathode showed that four electrons per molecule of dye are required for the reduction and that the amines are the final reduction products both in acidic and basic media. The lanthanide–dye complexes are reduced in a similar manner to the free dye. The reduction of Eriochrome Violet B does not obey first-order kinetics, and the observed reaction rate may be related qualitatively to a disproportionation mechanism involving an unstable hydrazo compound. The coulometric and polarographic behavior of Eriochrome Violet B was compared with that of the uranium system, which is well known to involve a disproportionation step. (auth)

2898 DETECTION OF AN ANIONIC SULPHATOBERYLLIUM COMPLEX USING A MODIFIED ELECTRODIALYTIC TRACER TECHNIQUE. L. E. Szego and R. B. Temple (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Australian J. Chem., 15: 559-60(Aug. 1962).

An electrodialytic tracer method using Be^7 and anion-selective membranes in sulfate form were used to detect anionic beryllium sulfate complexes in 1 M Na_2SO_4 at pH 2. After 3 hr, ~5% of the original Be content of the central compartment was transferred to the anode chamber, while only ~0.005% was transported to the cathode compartment. In the case of 1 M LiCl and the chloride form of the membranes, the anode and cathode compartments contained 1 and 0.02%, respectively, of the Be in the central compartment. For perchlorate, no anionic transport was detected. (D.L.C.)

2899 ADSORPTION OF CESIUM BY JAPANESE ACID CLAY. Noboru Oi and Eijiro Ohashi (Tokyo Shibaura Electric Co., Ltd.). Bull. Chem. Soc. Japan, 35: 1306-9(Aug. 1962). (In English)

Japanese acid clay, a montmorillonite-type one, exhibited a special affinity for cesium-137 from an aqueous solution. The phase equilibrium of the adsorption was confirmed, and the K_d values were used to analyze the data. The K_d value of cesium was highest in pure water, but it was decreased by increasing the aqueous acid, alkali, and salt concentration. When clay which had been treated at 400 to 500°C was used, the K_d value increased two- or three-fold. This phenomenon corresponds to the formation of 10 Å c-axis spacing and the dispersion of the structural water of the clay. This peculiarity, however, appears only at a low cesium concentration, below 10^{-6} mol/l. At a higher cesium concentration, the adsorption of cesium depends simply on the cation exchange capacity of the clay; heat-treated clay showed a poorer adsorption. The adsorption of cesium from a fission products mixture was also simply examined. (auth)

2900 GAS-PHASE CONTROLLED MASS TRANSFER OF PACKED COLUMNS CORRELATED TO THE LOADING POINT. R. Lopes Cardozo (EURATOM, Ispra, Italy). Chem. Eng. Sci., 17: 783-95(Oct. 1962).

During a study of the performance of a packed column for the absorption of gaseous iodine, it was found that the results could be correlated with the help of a loading number Λ. This number is defined by

$$\Lambda = \frac{\text{the actual liquid flow rate}}{\text{the calculated liquid flow rate at the loading point}}$$

In combination with the loading-point correlation of GARNER, which was verified experimentally,

$$\left(\frac{G_{loading}}{3600\rho_G}\right)^2 \frac{S}{g} = \epsilon^3 \left(\frac{L}{G}\right)_{loading},$$

the efficiency of packed columns can be calculated with:

$$\left(\frac{H_G S}{\epsilon}\right) = [(Sc)^{0.5}(Re')^{\beta}] \times [(A)^b f(We')] \times \left[\left(\frac{D}{D_p}\right)^c \left(\frac{f}{D_p}\right)^d\right]$$

mass-transfer = gas group × liquid group × column dimensions group

This equation, valid for gas-phase controlled mass transfer, has the following numerical values of the exponents:

Packing	a	b	c	d
Raschig-rings	0·44	−0·39	0·65	0·195
Berl-saddles	0·77	−0·45	0·28	0·195

The introduction of a modified Weber-Froude number (We') follows from the consideration that the dispersion of the absorption liquid is, apart from being a function of the amount of liquid, also a function of its physical properties. The dependency on We' is given in a graphical form. The standard deviation of the experimental H_C-values ranges from 7 to 30 per cent for the various packings and packing sizes. (auth)

2901 ROLE OF ATOMIC VALENCE STATE ENERGIES IN THE DETERMINATION OF SHAPES OF HYDRIDE MOLECULES. D. A. Hutchinson (Mathematical Inst., Oxford). Trans. Faraday Soc., 58: 1669-78(Sept. 1962).

The shapes of some hydrides, AH_2 and AH_3, are discussed in relation to the appropriate valence state energies of the atom A. These valence-state energies are determined as a function of the HAH bond angle. Similarly, the ground state and first excited state of acetylene are treated by considering the appropriate valence states of C_2. (auth)

Analytical Procedures

Refer also to abstracts 2721, 2722, 2723, 2724, 2726, 2727, 2728, 2729, 2730, 2731, 2732, 3674, 3676, 3679, and 3717.

2902 (BNL-5521) THE MICRODETERMINATION OF CARBON IN URANIUM METAL AND URANIUM CARBIDE. S. J. Tassinari (Brookhaven National Lab., Upton, N. Y.). [June 13, 1961]. Contract [AT-30-2-GEN-16]. 13p.

A modified Pregl technique is applied to the determination of microgram amounts of carbon in uranium metal and uranium carbide. A preliminary separation is required to determine free carbon in uranium carbide. The method permits the determination of (0.01 ± 0.0005) % carbon. The relative precision improves to ±0.5% at 4% carbon. For carbon in uranium metal, a 20-50 milligram sample is employed. The small sample size is an advantage since uranium requires special handling due to its pyrophoric nature. A 10-milligram sample suffices for the determination of total carbon in uranium carbide. The micro procedure requires less shielding and manipulation of irradiated material and is especially appropriate when only small samples are available. (auth)

2903 (BNL-5628) DETERMINATION OF LEAD IN METEORITES BY ALPHA ACTIVATION ANALYSIS. James C. Cobb (Brookhaven National Lab., Upton, N. Y.). [1960]. Contract [AT(30-2)-Gen-16]. 14p.

An alpha activation method has been devised whereby the abundances of Pb^{204}, Pb^{206} and Pb^{208} can be determined on one gram samples with a sensitivity of about 5×10^{-9} gm/gm for Pb^{206} and Pb^{208} and 1×10^{-9} gm/gm for Pb^{204}. Results on three meteorite samples, Canyon Diablo troilite, the carbonaceous chondrite Murray, and the enstatite achondrite Norton County, indicate the presence of radiogenic lead apparently unsupported by uranium and thorium. One explanation is that these meteorites incorporated this lead when they crystallized. (auth)

2904 (PG-Report-374) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF COMBINED NITROGEN IN ENRICHED URANIUM POWDER. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 10p.

The N_2 is converted to NH_3 which is then steam-distilled and determined absorptiometrically using phenate reagent. The method is suitable for the determination of N_2 in the range 10 to 500 ppm. (J.R.D.)

2905 (RFP-279) THE RADIOCHEMICAL DETERMINATION OF AMERICIUM IN THE PRESENCE OF PLUTONIUM IN URINE. D. L. Bokowski (Dow Chemical Co. Rocky Flats Plant, Denver). [1961]. Contract AT(29-1)-1106. 18p.

Americium is precipitated with bismuth phosphate from a nitric acid-digested urine sample. The bismuth phosphate is wet-ashed, dissolved in 6N−HCl, and the americium is precipitated with lanthanum fluoride. The lanthanum fluoride is metathesized to the hydroxide, and the precipitate is dissolved in 2N-nitric acid. Removal of concurrently metabolized plutonium is accomplished by liquid-liquid extraction of the nitric acid solution with 0.1-M di(2-ethylhexyl)phosphoric acid (D2EHPA) in chloroform. The purified americium is carried on lanthanum fluoride. The precipitate is slurried onto a stainless steel planchet and counted in a low-background proportional alpha counter. The method is effective for quantitative separation from plutonium and uranium. Quantities of the order of 0.5 dpm of americium can be detected in a urine sample. (auth)

2906 (WAL-TR-823/3) AN ION EXCHANGE-PHOTOMETRIC METHOD FOR THE DETERMINATION OF URANIUM IN STEEL. Thomas A. Ferraro and Walter F. Czyrklis (Watertown Arsenal, Mass.). Mar. 1962. 20p. (AD-274636)

An ion-exchange separation scheme was developed for the determination of U in steel. Anion exchange from a nitric acid solution is employed. Uranium is determined by the basic peroxide photometric method after its separation. A detailed procedure and data supporting the method are given. (auth)

2907 (WAL-TR-823.5/1) APPLICATIONS OF A SPECTROGRAPHIC-SOLUTION TECHNIQUE TO ANALYSIS OF IRON, TITANIUM, VANADIUM, AND ZIRCONIUM ALLOYS. Fred G. Howell and William K. Murray (Watertown Arsenal, Mass.). Mar. 1962. 19p. (AD-274637)

A spectrographic-solution technique has been applied to the analysis of certain Fe, Ti, V, and Zr alloys. The samples, after dissolution in an appropriate acid, are excited with a high-voltage spark using a commercial rotating-disk unit. Suitable line pairs are selected and calibration curves drawn using synthetic alloy solutions prepared from pure metals. The coefficient of variation for analysis of representative samples of each of the above alloy systems was determined. (auth)

2908 (Y-1406) SPECTROPHOTOMETRIC DETERMINATION OF TRACE ARSENIC IN ALUMINUM ALLOYS, ALUMINUM, URANIUM, AND LEAD. L. M. Steckel and J. R. Hall (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Sept. 21, 1962. Contract W-7405-eng-26. 18p.

A spectrophotometric method using silver diethyldithiocarbamate (AgDDC) has been successfully applied for the determination of trace quantities of arsenic in aluminum alloys, aluminum, uranium, and lead. Sample preparation procedures were developed for each of the various matrices. The measurement of the arsenic content of the sample is the same, regardless of matrix. The minimum quantity of arsenic detectable for the aluminum alloys and aluminum has been established to be 0.5 microgram per gram of sample; for uranium and lead the lower detection limit was 0.3 microgram per gram of sample. (auth)

2909 (EURAEC-383) RESEARCH ON ZIRCONIUM HYDRIDE IN ZIRCALOY-2 AND Zr–Nb ALLOYS. Quarterly Report No. 3, April 1 to June 30, 1962. (Siemens-Schuckertwerke A. G., Erlangen, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 024-61-10-RDA. 61p. A Translation.

A description is given of the determination of hydrogen in zirconium alloys by hot-extraction under a high vacuum. The sensitive gas chromatographic analysis made it possible to determine hydrogen contents of the order of magnitude of a few ppm. The relative error is ab. ± 4%. (auth)

2910 APPLICATIONS OF REVERSED-PHASE PARTITION CHROMATOGRAPHY OF URANIUM. T. J. Hayes (United Kingdom Atomic Energy Authority, Springfields Works, Lancs, Eng.) and A. G. Hamlin. Analyst, 87: 770-7 (Oct. 1962).

Reversed-phase partition chromatography is shown to be a convenient and simple method for the quantitative separation and recovery of uranium either from impure solutions of unknown origin or from solutions of uranium alloys. The separation process is studied and shown to obey a Freundlich-type isotherm from both nitric acid and hydrochloric acid media. Applications of the technique to specific problems in the analysis of uranium are briefly outlined. (auth)

2911 DETERMINATION OF DEUTERIUM IN ORGANIC COMPOUNDS. Nobuo Tamiya (Tokyo Medical and Dental Univ., Tokyo). Bull. Chem. Soc. Japan, 35: 863-5 (June 1962). (In English)

A device to simplify the deuterium analysis of organic compounds is described. The combustion of organic samples and the reduction of deuterium containing the water produced were both carried out in sealed glass tubes. By this procedure one could completely avoid the "memory effect" and get satisfactory results, as shown by the examples of amino acid analysis. (auth)

2912 RAPID MICRODETERMINATION OF DYSPROSIUM IN TERBIUM OXIDE BY NEUTRON ACTIVATION AND γ-RAY SPECTROMETRY. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo). Bull. Chem. Soc. Japan, 35: 873-5(June 1962). (In English)

Dysprosium in terbium oxide powder was determined by a simple method involving 1 min irradiation with pile neutrons of 3×10^{11} n/cm^2/sec and repeated γ-ray spectrometry using a 2 in. thick sodium-iodide crystal attached to a 256-channel pulse-height analyzer. Both interferences and the self-shielding effect were negligible. The coefficient of variation of single analyses was 5.2% for a 24 mg sample of 48 ppm dysprosium content. (auth)

2913 DETERMINATION OF SMALL AMOUNTS OF COPPER AND IRON WITH X-RAY FLUORESCENT SPECTROSCOPY. COMBINATION WITH ORGANOMETALLIC PRECIPITATION. Kichinosuke Hirokawa and Hidehiro Gotô (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 35: 961-4(June 1962). (In English)

The simultaneous determination of small amounts of copper and iron with x-ray fluorescent spectroscopy combined with organic precipitation was investigated. Using an alizarin blue solution, which reacts with copper and iron at a low pH value, as the precipitant, satisfactory results were obtained. The amounts of copper and iron in aluminum, zinc, manganese, and nickel were rapidly determined with x-ray fluorescent spectroscopy after this separation. (auth)

2914 DETERMINATION OF URANIUM IN THORIUM BY X-RAY FLUORESCENT SPECTROSCOPY. THE ORGANOMETALLIC PRECIPITATION METHOD. Kichinosuke Hirokawa and Hidehiro Gotô (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 35: 964-6(June 1962). (In English)

A method for the determination of a small amount of uranium in thorium using the separation method with precipitation, combined with x-ray fluorescent spectroscopy, was investigated. About 100 μg of uranium in thorium could be determined simply and rapidly by using alizarin blue as the precipitant for uranium and EDTA as the masking reagent for thorium. (auth)

2915 CHEMICAL USE OF THE ABSORPTION OF SOFT γ-RAYS, β-RAY-EXCITED X-RAYS AND K-CAPTURE X-RAYS. II. APPLICATION TO THE ANALYSIS OF A BINARY ALLOY AND THE DETERMINATION OF A HEAVY ELEMENT IN A MULTI-COMPONENT SYSTEM. Tadashi Nozaki (Electrical Communication Lab., Tokyo). Bull. Chem. Soc. Japan, 35: 1029-32(June 1962). (In English)

The absorption phenomenon of soft γ rays, β-ray-exited x rays and K-capture x rays was applied to the following two kinds of analyses: (1) Analysis of solder (simultaneous determination of the composition of a binary system and the sample thickness), and (2) determination of barium or lead in glasses (determination of an element of high atomic number in a multi-component system). Two photon beams of energies suitable for each purpose were chosen, and for the latter purpose the relationship between the absorption coefficient of an element and the photon-beam energy was used. The results were in good agreement with those obtained by usual chemical analysis. (auth)

2916 CHEMICAL USE OF THE ABSORPTION OF SOFT γ-RAYS, β-RAY-EXCITED X-RAYS AND K-CAPTURE X-RAYS. III. APPLICATION TO COLUMN-CHROMATOGRAPHIC SEPARATION OF HALOGEN COMPOUNDS. Tadashi Nozaki (Electrical Communication Lab., Tokyo). Bull. Chem. Soc. Japan, 35: 1032-7(June 1962). (In English)

The absorption technique of soft γ rays, β-ray-excited x rays and K-capture x rays was successfully applied to column-chromatographic separation and purification of halogen compounds. By this technique, the behavior of the iodine- and bromine-containing compounds in the column was determined in situ, and important information for column chromatography, including the retention volume, was obtained at an early stage of adsorption. The technique was also satisfactorily applied to the frontal analysis of halogen compounds. An excellent method for the preparation of pure 4-iodobiphenyl by the use of the in situ determination was provided. (auth)

2917 ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF BORON USING TIRON AS A NEW REAGENT. Kazuo Hiiro (Osaka Industrial Research Inst.). Bull. Chem. Soc. Japan, 35: 1097-1101(July 1962). (In English)

A simple spectrophotometric method using tiron for boron in aqueous solutions is described which results in a very stable 1 : 1 boron-tiron complex. Beer's law is obeyed in the range of 0.40 to 3.20 ppm boron at the wavelengths 252 and 306 mμ. The effects of different salts are shown. As the temperature affects the absorbance, absorption measurements should be made at constant temperature. (D.L.C.)

2918 SPECTRAL METHOD OF Sr^{87} DETERMINATION. A. G. Zhiglinski, A. N. Zaidel, and G. G. Kund. Geokhimiya, No. 11, 976-81(1962). (In Russian)

A spectral method for determining the isotope content of strontium was determined. The method is based upon photoelectric measurement of intensities of the hfs components of the line of Sr II 4078 Å, corresponding to various isotopes. The conditions of excitation and registration of this line in the interval of Sr^{87} content −7.0−52.6% were investigated. The possibility of using methods of analysis with and without standards is shown. The results of spectral and mass spectrometric measurements are compared. (auth)

2919 POLAROGRAPHIC DETERMINATION OF RUTHENIUM. Donald T. Sawyer, Richard J. Kula, and Allan L. Budd (Univ. of California, Riverside). J. Electroanal. Chem., 4: 242-7(Oct. 1962).

A method for the polarographic determination of ruthenium is discussed using basic sodium gluconate as the supporting electrolyte. The half-wave potential is −0.67v versus the saturated calomel electrode for 0.1 F sodium gluconate at pH 14. For these conditions the diffusion current constant, I, is 1.18 (maximum rather than average current). This constant is applicable for ruthenium concentrations from 1×10^{-4} to 5×10^{-3} F; analyses in this concentration range have an average deviation of 2.1%. This procedure and precautions for sample preparation are discussed. Platinum causes serious interference, but low concentrations of palladium and osmium can be tolerated. Iridium and rhodium do not interfere. (auth)

2920 EXTRACTION AND PHOTOMETRIC DETERMINATION OF SMALL QUANTITIES OF In IN TIN MATERIALS. I. S. Levin and T. G. Azarenko. Zavodsk. Lab., 28: 1313-16(1962). (In Russian)

A combined extraction of In and Sn from sulfuric solutions by a mixture of alkylphosphoric acid in octane followed by re-extraction of In by hydrobromic acid is described. Photometric determination of In is made by reaction with rhodcmine 6 Zh; sensitivity is 1×10^{-4}% In. (tr-auth)

2921 STUDY OF A NEW ANALYTICAL REAGENT—ALBERON AND ITS INTERACTION WITH BERYLLIUM IONS. L. P. Adamovich, O. V. Morgul-Meshkova, and B. V. Yutsis (Kharkov State Univ.). Zh. Analit. Khim., 17: 678-84(Sept. 1962). (In Russian)

Three constants of acid dissociation of dichlorosulfodimethylhydroxyfuxon-dicarboxylic acid (alberon) and the molar extinction coefficients of all its anions at λ = 525 mμ were determined. The composition of an alberon-beryllium compound (1 : 1) at pH 4.5 which is the most suitable for analytical purposes was established by two independent methods. Its unstability concentration constant was calculated. Data obtained were used for the comparison, evaluation, and improvement of the known analytical methods for the photometric determination of beryllium by means of alberon. (auth)

2922 SPECTROPHOTOMETRIC STUDY OF REAGENTS FOR INDIUM DETERMINATION. A. K. Babko and P. P. Kish (Uzhgorod State Univ., USSR). Zh. Analit. Khim., 17: 693-9(Sept. 1962). (In Russian)

A study was made of the spectrophotometric characteristics of 16 reagents forming colored compounds with indium. Absorption spectra of the molecular forms of the reagents, ionic forms, and also of their complexes with indium were measured. The shift of λ_{max} was calculated; the values of the molar extinction coefficients and the integral spectrum areas are given. The pH effect on the absorption of the reagents and their complexes with indium was studied; optimum conditions of complexing were found, and the composition of some complexes was established. A comparison of all the studied reagents for indium was made on the basis of the data obtained. The following criteria were taken into account: the shift of λ_{max} on the formation of a colored compound; the absolute and relative variations of the molar coefficient on the conversion from the molecular form of the reagent to its complex with indium; the difference of the pH values of the complex formation and of the formation of the salt form of a reagent. On the basis of the data obtained, methylthymol blue, xylenol orange, and eriochrome cyanine are considered to be the best of all the reagents studied. (auth)

2923 PURPUROGALLIN AS A REAGENT FOR THE SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM. I. P. Alimarin, I. V. Puzdrenkova, and S. Ya. Dolnikova (Moscow State Univ.). Zh. Analit. Khim., 17: 700-3(Sept. 1962). (In Russian)

Absorption spectra of aqueous-dioxan solutions at various pH were studied. $K_{dissoc.}$ of purpurogallin was determined at the ionic strength of 0.1; pK = 6.35 ± 0.25. A method was developed for the determination of 0.09−1 γ/ml of zirconium with purpurogallin in the presence of not more than 50-fold quantities of iron. (auth)

2924 ON POLAROGRAPHIC BEHAVIOUR OF TUNGSTEN, NIOBIUM, TITANIUM AND IRON WHEN PRESENT TOGETHER IN PYROPHOSPHORIC ACID SOLUTIONS. D. I. Kurbatov and I. S. Skorynina (Inst. of Chemistry, Academy of Sciences, USSR). Zh. Analit. Khim., 17: 711-17(Sept. 1962). (In Russian)

The polarographic behavior of tungsten in $H_4P_2O_7$ solutions of various concentrations was studied. It was established that in 18 N $H_4P_2O_7$ tungsten is reversibly reduced and gives one clearly defined wave. The value of the limiting current is a linear function of the tungsten concentration. The half-wave potential of tungsten is shifted considerably towards more negative potentials on the decrease of the $H_4P_2O_7$ concentration. Optimum conditions were found for the polarographic determination of tungsten in the presence of niobium. The most favorable conditions for the determination of niobium are 17−18 N $H_4P_2O_7$. The determination of tungsten in the presence of titanium was carried out in 10 N $H_4P_2O_7$ ($H_4P_2O_7 : H_2O$ = 1 : 1 by volume). Conditions were found for the determination of tungsten, niobium, titanium, and iron when present together. (auth)

2925 ON THE DETERMINATION OF ACTIVE OXYGEN IN PEROXIDE CERIUM COMPOUNDS. S. Z. Makarov and L. V. Ladeinova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, Moscow). Zh. Analit. Khim., 17: 743-7(Sept. 1962). (In Russian)

A method for the determination of active oxygen in cerium peroxide compounds by titrating with a 0.1 N solution of $KMnO_4$ in a sulfuric acid medium and doubling the results obtained was found to be applicable only up to ~20% of H_2O_2 content in the liquid phase. Moreover it was difficult to establish the end of the titration with $KMnO_4$ and the beginning of oxidation of Ce^{3+} into Ce^{4+}. Data on the content of active oxygen in cerium peroxide compounds were low. Taking into account the disadvantages of certain

methods, a method is recommended for the determination of active oxygen which is based on the measurement of the volume of oxygen evolved on the thermal decomposition of cerium peroxide compounds. (auth)

2926 A SAFE SEMIAUTOMATIC FLUORINATION SYSTEM FOR THE PREPARATION OF UF_6 MASS SPECTROMETER SAMPLES. J. K. Reusch and R. D. Ohlinger (National Lead Co. of Ohio, Cincinnati). Aug. 1, 1962. Contract AT(30-1)-1156. 22p. (TID-17284)

To be published in TID-7655, Proceedings of the Sixth Conference on Analytical Chemistry in Gatlinburg, Tenn., Oct. 9-11, 1962.

All uranium samples are converted to gaseous UF_6 to perform isotopic analyses with mass spectrometers. The ever-present hazards associated with the fluorination process prompted the design and construction of a safe, semiautomatic fluorination system. The fluorination system is securely mounted in a hood. Nearly all of the operations are performed by remote control from a semiautomatic electromechanical programmer. The fluorine gas is controlled with bellows seal valves actuated by air-to-open motors. Liquid nitrogen in Dewar flasks is raised and lowered with air cylinders. A transparent explosion shelter is automatically positioned around the sample tube prior to the fluorination reaction. The large hood door is automatically closed when fluorine gas is being transferred and during the fluorination reaction. This system has been thoroughly tested and evaluated in routine operation. One-half gram samples of U_3O_8 are routinely converted to UF_6 in less than five minutes. The use of this system has minimized the exposure of personnel to those hazards associated with the handling of fluorine. (auth)

2927 DEVELOPMENTS IN APPLIED SPECTROSCOPY. VOLUME 1. Proceedings of the Twelfth Annual Symposium on Spectroscopy Held in Chicago, Illinois, May 15-18, 1961. W. D. Ashby, ed. New York, Plenum Press, 1962. 267p. $9.00.

Thirty-nine articles are included; separate abstracts were prepared for 5; one article on spectral excitation with stabilized plasma jets was previously abstracted in NSA. The articles not abstracted include information on x-ray spectroscopy, ultraviolet and visible spectroscopy, and infrared and Raman spectroscopy and gas chromatography. (P.C.H.)

2928 X-RAY SPECTROMETRIC DETERMINATION OF THORIUM IN PURIFIED URANIUM MATERIALS. G. R. Blank and H. A. Heller (National Lead Co. of Ohio, Cincinnati). p.3-15 of "Developments in Applied Spectroscopy. Volume 1." New York, Plenum Press, 1962.

An x-ray spectrometric method for the determination of thorium in a variety of purified uranium materials is presented. The thorium is separated from the uranium prior to x-ray determination by a 2-thenoyltrifluoroacetone–xylene extraction. An acid solution of the reextracted thorium is irradiated in a 100-kv x-ray spectrograph after the addition of strontium as an internal standard. A statistical study indicated a limit of error of ±7.7 ppm over the concentration range from 100 to 1000 ppm of thorium. (auth)

2929 FLUORESCENT X-RAY SPECTROGRAPHY: DETERMINATION OF TRACE ELEMENTS. William J. Campbell and John W. Thatcher (Bureau of Mines, College Park Metallurgy Research Center, Md.). p.31-62 of "Developments in Applied Spectroscopy. Volume 1." New York, Plenum Press, 1962.

Discussion is given on the merits of fluorescent x-ray spectrographic instrumentation and techniques for determining trace elements. Limits of detectability for trace elements in metal, oxide, solution, or mineral samples range from 0.1 to 100 ppm, depending on the element being determined, over-all sample composition, and complexity of x-ray spectra; limits of detectability range from 0.01 to 1 μg for elements that have been preconcentrated by a chemical of physical process, for example, by ion-exchange membrane. Fluorescent x-ray spectrography can be used to obtain absolute values (by preparation of standard samples) or relative values based on standards analyzed by other means. Since x-ray techniques are nondestructive, both standards and unknowns are conserved for use in other evaluation procedures. (auth)

2930 ADVANCES IN HIGH-RESOLUTION X-RAY SPECTROMETRY. E. J. Jossem (Ohio State Univ., Columbus). p.63-75 of "Developments in Applied Spectroscopy. Volume 1." New York, Plenum Press, 1962.

Recent advances in technique and interpretation in high-resolution, precision x-ray spectrometry are reviewed. Topics discussed include improvements in x-ray generation and detection systems, the thickness effect in x-ray absorption measurements, temporal changes in the spectrometric properties of analyzing crystals, and computational techniques for correcting spectra for instrumental resolving power and for the effects of inner electron states. Applications of the advances to the investigation of the electron energy band structure of solids, to studies of crystal perfection, and to the establishment of precision x-ray wavelength scales are also discussed. (auth)

2931 ANALYSIS OF EUROPIUM OXIDE FOR RARE EARTH ELEMENTS AND OTHER IMPURITIES. J. T. Rozsa and J. Stone (National Spectrographic Labs., Inc., Cleveland). p.187-93 of "Developments in Applied Spectroscopy. Volume 1." New York, Plenum Press, 1962.

Quantitative spectrographic procedures were applied to the analysis of europium oxide. Because of its relative volatility in comparison to the other rare earth elements, the total-energy and carrier-method approach had to be modified to minimize background. Some 20 elements are included in the range of 1 to 10,000 ppm. Precision was found to be 5 to 20%. (auth)

2932 THE VISIBLE AND NEAR-INFRARED ABSORPTION SPECTRA OF SOME TRIVALENT ACTINIDE AND LANTHANIDE ELEMENTS IN $DClO_4$ AND IN MOLTEN NITRATE SALTS. W. T. Carnall and P. R. Fields (Argonne National Lab., Ill.). p.233-47 of "Developments in Applied Spectroscopy. Volume 1." New York, Plenum Press, 1962. (TID-13242)

Observations of absorption spectra of trivalent actinide and lanthanide ions in $LiNO_3$–KNO_3 eutectic at 150°C in the region between 0.36 and 2.5 μ are reported. Transitions to low-lying excited states were observed in crystals of both actinide and lanthanide elements in the near-infrared region (1.3–2.5 μ) and thus would be predicted to be observable in solution. However, the existence of intense solvent absorption bands in aqueous solution above 1.3 μ constitutes a severe limitation on the use of that medium. In the nitrate eutectic there were essentially no interfering solvent absorption bands between 1.3 and 2.5 μ. It was also possible to observe portions of this region in deuterated solvents, and thus to compare over an extended range the effects of different ligand fields on 4f and 5f electrons. The bands observed in the near-infrared region should prove to be of analytical importance since the extinction coefficients appear to be comparable to many of the more intense bands in the visible region. (auth)

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Refer also to abstracts 2691, 2698, 2699, 2700, 2701, 2702, 2703, 2704, 2705, 2706, 2707, 2712, 2713, 2736, 2737, 3264, 3842, 3872, 3876, and 3905.

2933 (AAEC/TM-155) DISSOLUTION OF HIGH DENSITY BERYLLIA COMPACTS. A. Ekstrom, M. S. Farrell, and R. B. Temple (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Sept. 1962. 13p.

The dissolution of dense beryllia was studied in a variety of reagents. The dissolution rates were too slow to be of practical importance except those for hydrofluoric acid, sulfuric acid, and mixtures of sulfuric and phosphoric acids. The reaction with hydrofluoric acid was studied in more detail in an attempt to throw some light on the dissolution process. The initial dissolution rate appeared to be proportional to the square of the acid concentration between 0 and 20M. An apparent activation energy of 12 Kcal/mole BeO was obtained from the temperature coefficient of the dissolution. (auth)

2934 (AD-273673) THE KINETICS OF IONIZATION PROCESSES IN GASES. Howard Myers (Aerospace Corp., El Segundo, Calif.). Dec. 1961. Contract AF04(647)-930. 95p. (TDR-930(2119)TR-2)

Currently available knowledge of the kinetics of ionization is presented. The production of ionization is covered by a description of electrical discharges in gases, including direct and alternating current discharges. Photoionization and ionization by shock waves are described. The measurement of ionization includes a description of electrostatic probes, microwave probing signals, mass spectrometer probe, and shock tubes. Photoionization instrumentation is described. Results of kinetic investigations are presented and the ionization processes occurring in the atmosphere are analyzed. (auth)

2935 (AD-274000) PARAMAGNETIC RESONANCE SPECTRA OF RARE EARTH IONS IN THE CRYSTAL FIELD OF CALCIUM FLUORIDE. Technical Note No. 18. W. Low (Hebrew Univ., Jerusalem). Jan. 1962. Contract AF 61(052)-59. 11p. (AFOSR-2167)

Paramagnetic resonance data of various rare earth ions in the crystal field of calcium fluoride are presented. It is found that there are at least three types of symmetries, cubic, axial, and trigonal. Some spectra of cerium (3+), ytterbium (3+), erbium (3+), and neodymium (3+) are presented. (auth)

2936 (AD-276118) NUCLEAR MAGNETIC RESONANCE WITHIN AN ANTIFERROMAGNETIC BLOCH WALL. Technical Report No. 4. David I. Paul (California. Univ., Los Angeles). May 14, 1962. Contract Nonr 233(63). 29p.

The effect of bound spin wave excitation spectrum existing within an antiferromagnetic Bloch wall was calculated on the line width and relaxation times of the magnetic resonance of nuclei existing within the wall. A relaxation time, caused by excitation of the transverse components of the electron spin by the resonance field, is shown to be smaller in antiferromagnets than is ferromagnets due to the larger minimum wall excitation energy. The line width due to indirect coupling of the nuclear spins through the virtual excitation of a spin wave, however, proved to be increased by the square root of the ratio of the anisotropy to the stiffness parameters compared to the uniform antiferromagnet. This may account for the rather large line widths observed in NMR experiments in antiferromagnets. A second nuclear line width, resulting from the variation of the deviation of the longitudinal component of the electron spin from the center to the edge of the wall was also calculated. Numerical results were obtained and, where possible, compared with experiment. (auth)

2937 (AECL-1641) OBSERVATIONS ON THE THERMAL CONDUCTIVITY OF URANIUM OXIDE. J. E. May, M. J. F. Notley, R. L. Stoute, and J. A. L. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1962. 17p.

The high thermal conductivity of certain uranium dioxide single crystals results from their hypostoichiometric composition, and not from the absence of grain boundaries. The columnar grains often obtained in irradiated fuel elements do not necessarily possess this high conductivity. However, the same high value can be obtained in polycrystalline sinters by controlling the stoichiometry. (auth)

2938 (ANL-FGF-318) ELECTRODEPOSITION OF PLUTONIUM FROM MOLTEN SALT SOLUTIONS OF Cs_2PuCl_6. M. B. Brodsky and G. F. Carleson (Argonne National Lab., Ill.). Nov. 30, 1961. Contract [W-31-109-eng-38]. 14p. (UAC-5872)

The usefulness of molten salt solutions of Cs_2PuCl_6 for plutonium electrolyses has been investigated. Plutonium metal has been recovered from solutions without the use of Pu anodes. Up to 66% of the Pu dissolved in salt solutions has been recovered with Ta cathodes. No net Pu was recovered from solution when Pu cathodes were used because of the reoxidation of the deposit by dissolved chlorine. The potential of the Pu(IV)-Pu(III) couple was measured and found to be –0.28 volts. (auth)

2939 (HW-67717) FAILURE TEST OF A DOUBLE CHAMBERED NaK-FILLED IRRADIATION CAPSULE. B. S. Kosut and R. D. Leggett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1961. Contract AT(45-1)-1350. 27p.

Tests are described in which a double chambered irradiation capsule containing NaK (sodium-potassium alloy) in its inner chamber was deliberately perforated to allow NaK (the heat transfer medium) and water to react within the capsule chambers. The tests simulated conditions of in-reactor failure of a capsule and those conditions that the capsule would necessarily endure after reactor shutdown and capsule discharge. Temperature and pressure monitoring during the test indicated that the NaK, water reaction was mild and self-regulating. The temperature adjacent to the hole in the NaK chamber momentarily rose to 400°C during one portion of the test, but no large pressure surges were observed and no apparent damage to components occurred. The formation of sodium hydroxide in the hole piercing the inner chamber apparently retarded a continuous reaction until the sodium hydroxide was either dissolved by the water or ejected from the perforations by deliberately introduced differential pressures from an external source controlled by the test engineer. (auth)

2940 (HW-SA-2175) THE USE OF CLINOPTILOLITE TO REMOVE POTASSIUM SELECTIVELY FROM AQUEOUS SOLUTIONS OF MIXED SALTS. L. L. Ames, Jr. and B. W. Mercer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 16, 1961. Contract AT(45-1)-1350. 6p.

Results of experiments show that the potassium specificity of clinoptilolite may allow the extraction and recovery of potash from mixed salt solutions on a commercial scale. (R.J.S.)

2941 (IS-359) THE EQUATION OF STATE OF SOLIDS AT LOW TEMPERATURE. N. Bernardes and C. A.

Swenson (Ames Lab., Ames, Iowa). [Aug. 15, 1961.] Contract [W-7405-eng-82]. 64p.

The agreement between experimental and theoretical equation of state calculations for low temperatures is satisfactory only for the solidified inert gases. While considerable data exist for these solids, most of these concern the PV relationship to 20,000 bars at temperatures of roughly 20°K. There is no reason to believe that significantly different data would be obtained in this pressure range at lower temperatures. Further data, however, such as densities as a function of temperature or even at the boiling point of helium, are either lacking or show contradictions well outside the estimated experimental uncertainties. An investigation of the reasons for the small discrepancies between theory and experiment for the inert gas solids which are described would involve the use of experimental PV data to derive empirical potentials. A logical extension of the theoretical work would be to the diatomic molecules, such as H_2, N_2 or O_2. The situation as regards the theory of the equation of state of metals at low temperature is much worse than for the inert gas solids, while the experimental situation is perhaps in better shape for the alkali metals, at least. The amount of data available for the temperature-dependent part of the equation of state of both metals and non-metals is extremely small. Adequate thermal expansion data and even heat capacity data to very low temperatures are not available for many of the simpler solids. Finally, solid-solid phase transformations have been observed under pressure at low temperatures in nitrogen and in helium. These are not completely understood at present. (R.J.S.)

2942 (K-1533) CATALYTIC GAS PLATING WITH NICKEL CARBONYL. W. E. Tewes, T. E. Zava, and T. B. Hoover (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nov. 23, 1962. Contract W-7405-eng-26. 31p.

Exploratory studies were made to determine the value of four potential catalysts in increasing the gas plating rate for nickel carbonyl. The catalysts studied were anhydrous ammonia, water vapor, oxygen, and hydrogen sulfide. No catalytic effect was observed for either ammonia alone or for water vapor alone. Oxygen was not tested alone. With hydrogen sulfide present in the 0.2 to 0.4% concentration range, significant improvement in plating rate was observed. The best results were obtained with mixtures of hydrogen sulfide and water vapor or mixtures of hydrogen sulfide and oxygen, using hydrogen sulfide concentrations of 0.2 to 0.8%, water vapor concentrations of 0.03 to 0.08%, and oxygen concentrations of 0.8 to 1.0%. The catalytic effect can also be used to reduce the temperature required for gas plating with nickel carbonyl. Using the hydrogen sulfide-oxygen mixture, nickel carbonyl gas plating was performed at room temperature on the following materials: iron, copper, aluminum, glass, paper, cardboard, cotton cloth, and cork. (auth)

2943 (NLCO-859) DETERMINATION OF LATTICE CONSTANTS OF POLYCRYSTALLINE (MONOCLINIC) URANIUM TETRAFLUORIDE. Peter R. Morris and Vernon Morton (National Lead Co. of Ohio, Cincinnati). Dec. 3, 1962. Contract AT(30-1)-1156. 25p.

A technique has been developed for the determination of lattice constants of polycrystalline (monoclinic) uranium tetrafluoride. Because of the comparatively large values and limited range of interplanar spacings available, it is desirable to employ a standard of known lattice constant to correct for systematic errors. The complexity of the uranium tetrafluoride diffraction pattern does not permit mixing a standard with the sample. It is necessary to examine the sample and standard separately. The diffractometer was employed for this work because it does not suffer from the problems associated with film shrinkage and because detectors may be employed which discriminate against unwanted wavelengths. The precision of the method is typically ±0.01 to ±0.02 Å on the unit cell lengths, and ±4 to ±8 minutes on the angle between axes. This is of the order expected. (auth)

2944 (NYO-9803) EVIDENCE FOR AN AUGER PROCESS IN CHEMISORPTION. Scientific Paper 808-D801-P1. P. M. Waters (Westinghouse Electric Corp. Research Labs., Pittsburgh). July 25, 1961. Contract [AT(30-1)-2176]. 9p.

Electron emission during the adsorption of a monolayer of oxygen on a "clean" tungsten surface is reported. This emission is attributed to the excitation of conduction band electrons during adsorption, probably as the result of Auger transitions to the chemisorbed state. Calculations based on this model of chemisorption agree qualitatively with the experimental yield. (auth)

2945 (ORNL-3293) THERMODYNAMIC PROPERTIES OF MOLTEN-SALT SOLUTIONS. Milton Blander (Oak Ridge National Lab., Tenn.). Oct. 31, 1962. Contract W-7405-eng-26. 98p.

Thermodynamics of molten salt solutions are described and discussed along with the thermodynamic properties of numerous salt solutions. The bibliography contains 133 references. (N.W.R.)

2946 (TID-13814) ELECTROCHEMICAL POTENTIALS OF IONS. Joseph E. Boggio and Robert C. Plumb (Worcester Polytechnic Inst., Mass.). [Sept. 15, 1961]. Contract AT(30-1)-2479. 8p.

It is shown that the electrochemical potential of a charged particle in a non-stoichiometric phase can be rigorously separated into two parts: $\bar{\mu}_i = \mu_i^s + \mu_i^{ns}$, where μ_i^s is the potential of the particle in the stoichiometric phase (Lange's real potential α_i) and μ_i^{ns} is the potential associated with the non-stoichiometry of the phase. When the departure from stoichiometry has excess electrical charge associated with it, it is shown that as a first approximation: $\bar{\mu}_i = \mu_i^s + eZ_i\psi$, where ψ is the electrostatic potential of the phase (i.e., the outer or cavity potential). The departure of this first approximation from the exact expression is estimated. The so-called surface potential is seen to result from the somewhat arbitrary division of the stoichiometric potential, μ_i^s, into a purely chemical part and electrical part. (auth)

2947 (TID-17203) EFFECT OF ISOTOPIC COMPOSITION ON SOLID-STATE SPECTRA. R. H. Misho, W. B. Zimmerman, and D. J. Montgomery (Michigan State Univ., East Lansing). [1962]. Contract AT(11-1)-400. 34p.

Techniques used in experiments on the isotopic composition of LiF are extended to work on additional LiF and LiH compositions at various temperatures. Experimental results indicate that variation of isotopic mass appears to be a useful probe for elucidating the photon-photon interaction in isotopically pure substances, wherein the main features of the elementary theory are borne out for the principal absorption peak. However, variation of isotopic composition in isotopically impure substances does little to clarify the photon-photon interactions. Use of isotopic composition variations in such substances does offer a potential use in the production of chemically identical materials with continuously varying optical properties. (J.R.D.)

2948 (TID-17216) REACTIONS OF SOLVATED IONS. Final Report. Henry Taube (Chicago, Univ.). Sept. 24, 1962. Contract AT(11-1)-378. 9p.

Brief summaries are presented on isotopic dilution stud-

ies on salts dissolved in CH_3OH, studies on metal and metal salts in solvents of the amine type, and studies on phosphato complexes of the pentammine Co(III) series. A list of papers published on reactions of solvated ions is included. (N.W.R.)

2949 (TID-17218) EFFECT OF LATTICE VIBRATIONS ON SPIN-SPIN RELAXATION TIMES IN SOME PARAMAGNETIC MATERIALS (thesis). Donald Wright (Case Inst. of Tech., Cleveland). June 1962. Contract AT(11-1)-623. 50p.

Spin-spin relaxation times associated with the displacements of spins from their equilibrium lattice sites are calculated as a function of temperature and magnetic field using the formulas given by Peterson. The relaxation times are calculated for the alpha and beta phases of solid He^3, $CuCl_2 \cdot 2H_2O$, and $Cu(NH_4)_2(SO_4)_2 \cdot 6H_2O$. If the mean square value of the spin displacements is given by the Debye-Waller formula, the He^3 relaxation times are only slightly dependent on temperature, whereas those of $CuCl_2 \cdot 2H_2O$ and $Cu(NH_4)_2(SO_4)_2 \cdot 6H_2O$ are proportional to the reciprocal of the temperature at high temperatures. The relaxation times of $CuCl_2 \cdot 2H_2O$ and $Cu(NH_4)_2(SO_4)_2 \cdot 6H_2O$ exhibit maxima as functions of magnetic field which produce maxima and minima in the nonresonance absorption curves. The relaxation times of He^3 were found to increase smoothly as H increased. The zero field relaxation times are an order of magnitude larger than those of Caspers for $Cu(NH_4)_2(SO_4)_2 \cdot 6H_2O$ at 60°K and in agreement at room temperature; however, the relaxation times calculated here increase more rapidly with increasing magnetic field than was measured. (auth)

2950 (TID-17253) THE COPRECIPITATION OF Sr^{+2} WITH ARAGONITE AND OF Ca^{+2} WITH STRONTIANITE BETWEEN 90° AND 100°C. Technical Report No. 2. H. D. Holland, M. Borcsik, J. Munoz, and U. M. Oxburgh (Princeton Univ., N. J.). [1962]. Contract AT(30-1)-2266. 39p.

Experimental techniques are described and results are presented on the coprecipitation of Sr^{+2} with aragonite together with some data on the coprecipitation of Ca^{+2} with strontianite between 90° and 100°C. (R.J.S.)

2951 (TID-17339) THERMAL EXPANSION OF POLYCRYSTALLINE LANTHANUM SESQUIOXIDE AND NEODYMIUM SESQUIOXIDE. R. E. Mistler, P. L. Ploetz, and J. A. Smith (Knolls Atomic Power Lab., Schenectady, N. Y.). [1961]. Contract W-31-109-eng-52. 10p.

The coefficient of linear thermal expansion and thermal expansion curves from room temperature to 1050°C are reported for hexagonal polycrystalline samples of lanthanum and neodymium sesquioxides. The measurements were made by the dilatometer method. (auth)

2952 (TID-17364) A KINETIC STUDY OF SILICA ADSORPTION ON THORIA SURFACES. Technical Report No. XVII. Jong S. Cho and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). May 15, 1962. Contract W-7405-eng-26. 20p.

The kinetics of silicate adsorption from aqueous colloidal ($SiO_2 \cdot nH_2O$) silicate sols on thoria (ThO_2) surfaces were determined at 100, 150, and 200°C in an autoclave system. The amount of chemisorbed silica on the thoria surface was determined by means of infrared spectroscopy. First order kinetics were observed in all cases with the anomalous result that the first order rate constant was found to vary with the initial amount of silica added to the system. These results have been correlated quantitatively by means of a strain model of adsorption involving two types of surface silicate bonding, both of which may be readily observed in the infrared spectrum. Initial adsorption occurs rapidly to produce one type of surface silicate followed by a slow transition to a second type of surface bonding, the latter transition representing the slow step in the adsorption process. (auth)

2953 (UCRL-6357) SOLUTIONS OF NONELECTROLYTES. Berni J. Alder (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 1, 1961. Contract W-7405-eng-48. 57p.

A review is presented of studies on solutions of nonelectrolytes covering pair potential, non-pairwise additivity of potential, spectroscopy in solution, equilibrium theory, and transport theory. (R.J.S.)

2954 (URCL-6752) THE CRYSTAL STRUCTURE OF Ru_9Be_{17}. Donald E. Sands, Quintin C. Johnson, Oscar H. Krikorian, and Kurt L. Kromholtz (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 23, 1962. Contract W-7405-eng-48. 15p.

Ru_9Be_{17} is body-centered cubic with a = 11.337 Å; there are eight formula units in the unit cell and the space group is Im3. A feature of the structure which is unusual for an intermetallic beryllide is the occurrence of a hole of radius 2.81 Å around the origin of the unit cell. Powder patterns show a corresponding isostructural osmium beryllide with a = 11.342 Å. (auth)

2955 (UCRL-6839-T(Summ.)) GROWTH OF BERYLLIUM OXIDE SINGLE CRYSTALS. Herbert W. Newkirk and Donald D. Kingman (California. Univ., Livermore. Lawrence Radiation Lab.). 1962. Contract [W-7405-eng-48]. 13p.

Techniques are being developed for synthesizing large single crystals of beryllium oxide for a variety of physical, mechanical, and chemical property measurements. This work has resulted in the routine production of crystals up to 5 mm in size. Results from physical chemical studies into the growth mechanism of these crystals indicate that crystals having even larger dimensions may be synthesized in the near future. The most successful technique developed has been the growth of crystals from a molten flux. Another method, water vapor transport, since abandoned because of its failure to yield large crystals, will also be described for information to those experimenters attempting to grow crystals by this method. (R.J.S.)

2956 (UCRL-9840) THERMODYNAMIC PROPERTIES OF GASEOUS METAL DIHALIDES. Leo Brewer, G. R. Somayajulu, and Elizabeth Brackett (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1961. Contract W-7405-eng-48. 51p.

The second and third law methods of thermodynamics are used to obtain the enthalpies of vaporization of the halides of Be, Mg, Ca, Sr, Ba, Zn, Cd, Hg, Sn, Pb, Ti, V, Cr, Mn, Fe, Co, Ni, and Cu. Molecular and free energy data necessary for such calculations are presented. The structure of bonding in these molecules is briefly discussed. (auth)

2957 (UCRL-9887) THE SPECTROPHOTOMETRY OF METAL-AMMONIA SOLUTIONS AT LOW TEMPERATURES. Marvin Gold and William L. Jolly (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1961. Contract W-7405-eng-48. 11p.

Two types of apparatus are described for measuring the absorption spectra of metal-ammonia solutions with the Cary Model 14 Spectrophotometer. One apparatus was used for dilute solutions at −70°; the other was used for more concentrated solutions and had provision for holding the

solutions at any temperature between their boiling points and −70°. (auth)

2958 (WADD-TR-61-72(Vol.VIII)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME VIII. ELECTRON SPIN RESONANCE IN POLYCRYSTALLINE GRAPHITE. L. S. Singer and G. Wagoner (National Carbon Co. Research Lab., Parma, Ohio). June 1962. Contract AF33(616)-6915. 17p.

The electron spin resonance of polycrystalline graphite is shown to be due to charge carriers, as for single crystals. For lampblack-base graphite, the variation in g-value with temperature agrees approximately with that for single crystal graphite if it is assumed that the spins effectively average out the anisotropic interactions by rapid intercrystallite diffusion. The magnitude and temperature dependence of the spin susceptibility were found to be in excellent agreement with McClure's theoretical predictions for the charge carriers in perfect graphite. Complications of measuring these materials are discussed, including effects of skin depth and microwave heating and the dependence upon crystallite size and sample purity. It was found that two types of impurities can affect the resonance; those which become ionized and shift the Fermi level, and large unionized atoms which do not shift the Fermi level but act as efficient scattering centers for shortening the spin-lattice relaxation time. (auth)

2959 (AEC-tr-5264) BORIDES OF THE RARE EARTH METALS. G. V. Samsonov and Yu. B. Paderno. Translation of "Boridy Redkozemel'nykh Metallov" (a publication of Publishing House of the Academy of Sciences, Ukrainian, SSR, Kiev, 1961). 104p.

Preparation, chemical and physical properties, and uses of alkaline earth, rare earth, and actinide borides are summarized and tabulated. The bibliography contains 162 references. (N.W.R.)

2960 (UCRL-Trans-599(L)) THE BEHAVIOR OF ELEMENTS IN TRACE QUANTITIES. A. K. Lavrukhina (Lavruchina). Translated from Chem. Listy, 53: 465-80 (1959). 28p.

The results of experiments are reported on the behavior of elements in very small concentrations during precipitation, extraction, electrolysis, distillation, and chromatographic separation on ion exchangers. The radioactive pure isotopes used in the experiments were Bi^{210}, I^{131}, Zr^{95}, Y^{91}, Ce^{141}, Ce^{143}, Ce^{144}, Fe^{59}, P^{32}, As^{76}, Co^{60}, Sb^{124}, Zn^{65}, and Nd^{147} on a standard slitted counter with a statistical error of less than ±5%. All the values given are the mean of six to twelve parallel experiments. (R.J.S.)

2961 PRODUCTION OF SINGLE CRYSTALS OF LITHIUM FLUORIDE WITH SELECTED ISOTOPIC RATIOS OF LITHIUM. C. F. Weaver and R. E. Thoma (Oak Ridge National Lab., Tenn.). Branched Chain, 18: 12-13(Oct. 1962).

Single crystals of lithium fluoride, 4.5 cm in diameter and approximately 7.5 cm in length, were made from lithium fluoride of the desired isotopic ratio by the Stockbarger technique. In this process, a molten salt in an inert container is moved through a temperature region which brackets the freezing point of the salt and possesses a steep thermal gradient. After growth, the crystals are annealed for nearly a week. The problem of crystal purity is briefly discussed. (R.J.S.)

2962 STABILITY OF CONDENSED PHOSPHATE COMPLEXES. I. ALKALINE-EARTH METAL COMPLEXES. Akira Roppongi and Takio Kato (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 35: 1086-92(July 1962). (In English)

Stability constants were measured with different methods for complexes of trimetaphosphate, tetrametaphosphate, and triphosphate with Mg, Ca, Sr, and Ba ions. It is shown that the triphosphate complexes are probably 1:1 complexes. The stability of complexes decreases monotonically from Mg to Ba, indicating that the complexes are not complicated rings. Comparisons are made with literature values. (D.L.C.)

2963 STABILITY OF CONDENSED PHOSPHATE COMPLEXES. II. RARE-EARTH METAL COMPLEXES. Akira Roppongi and Takio Kato (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 35: 1092-6(July 1962). (In English)

The stability constants of triphosphate complexes with rare earth metals were determined. The main complex species is ML_2, where M = metal and L = triphosphate. The relation between the stability constants and the atomic number is shown in a graph. Excess triphosphate can keep the rare earth metals in solution over a wide range of pH. (D.L.C.)

2964 THE VACUUM ULTRAVIOLET SPECTRUM OF DCl. J. G. Stamper (National Research Council, Ottawa). Can. J. Phys., 40: 1274-5(Sept. 1962). (NRC-6942)

During an investigation of the absorption spectrum of DBr in the vacuum ultraviolet region, two bands were found which could only be ascribed to DCl. An experiment is described in which conditions were identical with those used to obtain the spectrum of DBr. The spectra were photographed in the ninth order of a 10-meter grating spectrograph giving a dispersion of about 10 cm^{-1}/mm. (W.D.M.)

2965 DETERMINATION OF OXYGEN PRESSURES IN EQUILIBRIUM WITH URANIUM OXIDES UO_{2+x}. Paul Gerdanian and Maurice Dodé. Compt. Rend., 255: 665-7(July 1962). (In French)

The method of chemical equilibrium was used to determine the oxygen pressures in equilibrium with UO_{2+x}. The velocity at which the equilibrium is obtained depends on the composition of the oxide; the smaller the deviation from the stoichiometric composition UO_2, the faster the equilibrium obtained. The results are in complete disagreement with those of Berdese. From the composition $UO_{2.15}$ to $UO_{2.205}$ the pressures of equilibrium are in good agreement with those of Aronson and Belle. No curve was found with the same concavity as that found by Aronson and Belle. (J.S.R.)

2966 ISOTOPIC EXCHANGE BETWEEN FREE RADICALS AND DEUTERIUM. L. Radich and R. E. Mardaleishvili (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 146: 618-20(Sept. 21, 1962). (In Russian)

The marked deuterization of the reaction products resulting from the interaction of D atoms with various organic compounds is due to the isotopic exchange of the newly formed free radicals with D atoms. V. V. Voevodskiĭ et al. (Doklady Akad Nauk, 81: 215(1951)) assumed that D_2 molecules also participate in the reaction. Tests were carried out to prove this assumption, adding an ethylene and deuterium mixture to a stream of partially dissociated protium, expecting on the basis of the known reaction rate constants that the protium atoms form radicals according to $H + C_2H_4 \rightarrow \dot{C}_2H_5$ while no D atoms are formed by the $H + D_2 \rightarrow HD + D$ reaction. The reaction of the partially dissociated protium $H + H_2$ with olefins in the presence of molecular D_2 yielded markedly deuterated products, indicating that molecular D_2 participates in the exchange reaction. However, in similar experiments carried out in the absence of D atoms, such as the photolysis of acetone in the presence of molecular D_2, no such deuterated products could be discovered. As an explanation, it is postulated

that interaction with the glass or quartz walls accelerates catalytically the formation of D atoms. (TTT)

2967 THE NATURE OF THE LINEAR LUMINESCENCE SPECTRUM OF ZIRCONS. A. K. Trofimov. Geokhimiya, No. 11, 972-5(1962). (In Russian)

By comparing the spectra of zircon and phosphorus on the basis of zirconium orthosilicate activated by various rare-earth elements, it was proved that the groups of lines in the yellow-green and the blue region belong only to dysprosium and the ultra-violet group is called forth by the presence of gadolinium in the samples. (auth)

2968 ACIDITY MEASUREMENTS AT ELEVATED TEMPERATURES. I. URANIUM(VI) HYDROLYSIS AT 25 AND 94°. C. F. Baes, Jr. and Norman J. Meyer (Oak Ridge National Lab., Tenn. and Bowling Green State Univ., Ohio). Inorg. Chem., 1: 780-9(Nov. 1962).

The hydrolysis of uranium(VI) was measured in potassium nitrate solutions (I = 0.5 m) at 94.4°, using a glass electrode concentration cell with a vibrating reed electrometer null detector. With allowance for the glass electrode asymmetry potential drift, better than ±0.1 mv precision was obtained. Similar hydrolysis measurements were made at 25° to better establish the hydrolysis mechanism, which was found to be inconsistent with the proposed "core-links" series of hydrolysis products. Instead the results are consistent with the formation of only three species, UO_2OH^+, $(UO_2)_2(OH)_2^{3+}$, and $(UO_2)_3(OH)_5^+$, before precipitation occurs, for which equilibrium quotients of formation from uranyl ion and water (2×10^{-6} m, 1.2×10^{-6} m, and 6×10^{-17} m^3 at 25°; 6.5×10^{-5} m, 3.1×10^{-5} m, and 1.8×10^{-13} m^5 at 94°, respectively) were evaluated. From these, the heats of formation were estimated to be 11, 10.2, and 25.1 kcal, respectively. Overall hydrolysis increases rapidly with temperature, with the initial monomeric product, UO_2OH^+, becoming more stable with respect to dimerization to $(UO_2)_2(OH)_2^{3+}$. The trimeric species also becomes more stable with respect to the dimeric species; however, it is also the least stable with respect to precipitation of uranium trioxide and so (because of the decreasing solubility of the oxide) is of decreasing importance in the hydrolysis process with increasing temperature. (auth)

2969 COMPOUNDS OF HEXAVALENT AND PENTAVALENT URANIUM WITH THE ORDERED PEROVSKITE STRUCTURE. Arthur W. Sleight and Roland Ward (Univ. of Connecticut, Storrs). Inorg. Chem., 1: 790-3(Nov. 1962).

Phases with the composition A_2UBO_6 having the ordered perovskite structure were prepared where A = Ba or Sr and B = various divalent and trivalent cations which can adopt octahedral coordination with oxygen. With the trivalent cations, Cr, In, Sc, Y, and Er, it is assumed that the uranium is in the pentavalent state. The compound Ba_2CuUO_6 is shown to have a tetragonal distortion attributed to the Jahn-Teller effect. (auth)

2970 THE COMPOSITION AND PROPERTIES OF THE SOLID PRODUCED BY REACTION OF THORIUM WITH HYDROCHLORIC ACID. Ray S. Newbury and Alan W. Searcy (Univ. of California, Livermore and Berkeley). Inorg. Chem., 1: 794-8(Nov. 1962).

The solid produced by reaction of thorium metal with hot 12 N HCl has a composition $ThO_{1.3}Cl_{0.7}H_{1.3}$. Upon heating at below 300°, hydrogen is evolved, apparently reversibly, with a heat of activation of 2.3 kcal per mole of H_2. At higher temperatures, hydrogen is evolved with a heat of activation of about 25 kcal. Heating to 800° produces sublimed thorium tetrachloride and a residue of thorium dioxide and thorium metal. The principal initial reaction product probably is a thorium(IV)-oxide-hydride-hydroxide-chloride mixed crystal that evolves hydrogen slowly by an internal reaction $H^- + OH^- = O^{-2} + H_2$. (auth)

2971 THE KINETICS OF THE THALLIUM(I)-CERIUM(IV) REACTION IN NITRIC ACID. Mary K. Dorfman and J. W. Gryder (Johns Hopkins Univ., Baltimore). Inorg. Chem., 1: 799-805(Nov. 1962).

Rate data for the oxidation of thallium(I) by cerium(IV) in 6.18 f nitric acid at 53.9 ± 0.1° are interpreted as indicating the following mechanism for the reaction

$$2Ce(IV) \overset{K}{=} (CeIV)_2$$

$$Ce(III) + Ce(IV) \overset{K'}{=} (CeIII\ CeIV)$$

$$Ce(IV) + OH^- \underset{2}{\overset{1}{\rightleftharpoons}} Ce(III) + OH$$

$$Tl(I) + OH \underset{4}{\overset{3}{\rightleftharpoons}} Tl(II) + OH^-$$

$$Tl(I) + Ce(IV) \underset{6}{\overset{5}{\rightleftharpoons}} Tl(II) + Ce(III)$$

$$Tl(II) + Ce(IV) \xrightarrow{7} Tl(III) + Ce(III)$$

where Ce(IV) is monomeric cerium(IV), $(CeIV)_2$ is dimeric cerium(IV), and (CeIII CeIV) is a dimer of one cerium(III) and one cerium(IV). Employing a steady state approximation, microscopic reversibility, and an iterative least squares procedure, one obtains the following values for the equilibrium constants and groups of specific rate constants when the rate is expressed in terms of the disappearance of Ce(IV): K = 18, K' = 2, $k_1 = 1.33 \times 10^{-5}$, $k_5 = 3.81 \times 10^{-4}$, $k_2/k_3 = 0.021$, $k_3k_4/k_5k_7 = 5.4 \times 10^{-5}$, $k_4/k_7 = 2.6 \times 10^{-3}$, $k_6/k_7 = 1.52 \times 10^{-3}$. Concentrations are measured in moles/liter and time in seconds. (auth)

2972 DERIVATIVES OF TECHNETIUM CARBONYL. SYNTHESIS AND PROPERTIES OF THE CARBONYL HALIDES AND THE PENTACARBONYL HYDRIDE. J. C. Hileman, D. K. Huggins, and H. D. Kaesz (Univ. of California, Los Angeles). Inorg. Chem., 1: 933-8(Nov. 1962).

The carbonyl halides of technetium, $Tc(CO)_5X$ and $[Tc(CO)_4X]_2$ (X = Cl, Br, and I), were synthesized by the action of the halogens on technetium carbonyl. The carbonyl chlorides also are formed in solutions of the carbonyl in carbon tetrachloride at room temperature. These reactions are analogous to those found for the carbonyls of manganese and rhenium. On the other hand, only traces of a volatile carbonyl hydride of technetium can be isolated from a reaction sequence known to afford the pentacarbonyl hydrides of manganese and rhenium in good yields (from the respective carbonyls). Recovery of technetium from reaction residues as the dioxide and direct conversion of the latter to the carbonyl are reported. The new derivatives were characterized, and their infrared absorption spectra in the carbonyl region compared with improved spectra for the analogous compounds of manganese and rhenium. (auth)

2973 PREPARATION OF RUTHENIUM(II) BY CONTROLLED POTENTIAL REDUCTION. Garry A. Rechnitz (Univ. of Pennsylvania, Philadelphia). Inorg. Chem., 1: 953-4(Nov. 1962).

It was found possible to prepare stable solutions of ruthenium(II) in acidic chloride media by controlled potential reduction of ruthenium(IV) at a mercury pool electrode. Accurate control of the cathode potential is required to avoid H_2 evolution, and the pH must be kept below 2.5. Optimum conditions at an applied potential of −0.470 ± 0.001 volts were found in N_2-deaerated 4 M KCl adjusted to pH 1.5 with HCl. The resulting solutions of $RuCl_4^{2-}$ were lavender-blue and had absorption maxima at 538 and 610 mμ. (D.L.C.)

2974 FORMATION CONSTANTS OF THE COMPLEX SPECIES FORMED BY INTERACTION OF RARE EARTH N'-HYDROXYETHYLETHYLENEDIAMINE-N,N,N'-TRIACETATE COMPLEXES WITH AN EQUIVALENT AMOUNT OF BASE. Asim K. Gupta and Jack E. Powell (Ames Lab., Ames, Iowa). Inorg. Chem., 1: 955-6(Nov. 1962). (IS-407)

The constants for the reaction $RCh + OH^- \rightarrow RChOH^-$, where R = rare earth and Ch = HEDTA, were determined at 25°C and constant ionic strength (0.1 M KNO_3). The log K'_{RChOH} values fall in the range 3 to 5 and are relatively constant for each of the groups of light rare earths (La to Sm) and heavy rare earths (Ho to Lu), with the values being greater for the heavy rare earths by ~1.5 log units. (D.L.C.)

2975 THE PREPARATION AND PROPERTIES OF SOME LANTHANUM(III) MONOTELLUROOXIDES. Richard A. Kent and Harry A. Eick (Michigan State Univ., East Lansing). Inorg. Chem., 1: 956-8(Nov. 1962).

Oxytellurides of the formula Ln_2O_2Te, where Ln = La, Ce, Pr, Nd, Sm, Eu, Gd, or Dy, were prepared by reactions of the sesquioxides with Te vapor in H_2 at 500 to 960°C. The sesquioxides of Ho and the heavier lanthanoids either did not react or reacted only partially. Heating of the oxytellurides in air resulted in the formation of tellurates. Unit cell dimensions and densities are tabulated for all the oxytellurides prepared. (D.L.C.)

2976 CRYSTALLOGRAPHIC DATA FOR NEW RARE EARTH BORATE COMPOUNDS, $RX_3(BO_3)_4$. A. D. Mills (Bell Telephone Labs., Inc., Murray Hill, N. J.). Inorg. Chem., 1: 960-1(Nov. 1962).

Measurements of the lattice constants, densities, and unit cell volumes are reported for a new series of rare earth borates, $RX_3(BO_3)_4$, where R = Y or rare earth and X = Al or Cr. (D.L.C.)

2977 HYDRIDIC NATURE OF THE "LOWER OXIDE OF THORIUM." Leonard I. Katzin, Louis Kaplan, and Thomas Steitz (Argonne National Lab., Ill.). Inorg. Chem., 1: 963-4(Nov. 1962).

An experiment was conducted which unequivocally shows that the black residue formed by reaction of Th with HCl, contains hydridic hydrogen. The black residue, formed from Th and DCl-D_2O, was washed repeatedly with HCl-H_2O and then decomposed in HCl with catalytic fluorosilicic acid; the resulting hydrogen gas contained 87% HD, 12% H_2, and 1% D_2. It is concluded that the residue is a compound of Th(IV), perhaps ThO(X)H, where X is largely hydroxyl but may also be chloride. The yellowing of the black residue by a variety of agents is discussed. The corresponding U residue is discussed briefly. (D.L.C.)

2978 COMMENT CONCERNING THE EFFECT ON THE DIBORANE-PENTABORANE EXCHANGE REACTION OF THE REPORTED DEUTERIUM ISOTOPE EFFECT IN THE DECOMPOSITION OF DIBORANE. Joyce J. Kaufman (RIAS, Baltimore). Inorg. Chem., 1: 973-5(Nov. 1962).

The recent discovery that the BD_3 concentration is twice as large as that of BH_3 in the dissociation of B_2D_6 and B_2H_6, is shown to be related to the diborane-pentaborane isotopic exchange, in which B_2D_6-B_5H_9 is faster than B_2H_6-B_5D_9 exchange. The increase of D content of penta- and decaboranes with time is explained as being due to rapid H_2 evolution. The anomalously high appearance potential of BH_3^+ from B_2H_6 as compared with that for BD_3^+ from B_2D_6 is attributed to higher BD_3 pressures. A structure of B_2D_6 and B_2H_6 is proposed in which terminal B-D bonds are shorter than terminal B-H bonds and bridge B-D bonds are longer than bridge B-H bonds. (D.L.C.)

2979 OBSERVATIONS ON THE HYDROLYSIS PRODUCT DISTRIBUTIONS FOR SOME INNER TRANSITION METAL CARBIDES. C. P. Kempter (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 1: 975(Nov. 1962). (LADC-5409)

Similarities are pointed out in the hydrolysis product distributions of the rare earth carbides LaC_2 and CeC_2 and the actinide carbides ThC_2 and UC_2. The summations of the even- and odd-numbered carbon to hydrocarbons are nearly the same for the two pairs, LaC_2-CeC_2 and ThC_2-UC_2. The higher alkane percentages for ThC_2 and UC_2 confirm a prediction made by Palenik and Warf. (D.L.C.)

2980 HEAT CAPACITY AND ENTHALPY OF CORUNDUM IN THE TEMPERATURE INTERVAL FROM 500 TO 2000°C. V. Y. Chekhovskoi (Moscow Electrotechnical Inst.). Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR, 5: No. 8, 62-5 (Aug. 1962). (In Russian)

Empiric equations for the calculation of the enthalpy and the heat capacity of alumina were obtained from experimental data. The equations are correct in the temperature interval from 500 to 2000°C and can be used for checking and calibrating experimental calorimetric installations. The smoothed heat capacity and enthalpy values as calculated from the equations were in good agreement with the experimental data of others. (auth)

2981 HYDRIDES OF GERMANIUM. J. E. Drake and W. L. Jolly (Univ. of California, Berkeley). J. Chem. Soc., 2807-13(July 1962). (UCRL-10013)

Monogermane has been prepared by reduction of aqueous germanate solutions with tetrahydroborate (borohydride). Higher germanes, up to nonagermanes, have been prepared by decomposition of monogermane in an ozonizer-type silent electric discharge. The higher germanes were separated by gas-liquid chromatography and were identified by their vapor pressures, infrared spectra, mass spectra, and proton magnetic resonance spectra. (R.J.S.)

2982 THE CATALYTIC DECOMPOSITION OF BROMATE IN FUSED ALKALI NITRATES. Frederick R. Duke and Elizabeth A. Shute (Ames Lab., Ames, Iowa). J. Phys. Chem., 66: 2114-16(Nov. 1962). (IS-416)

The catalytic decomposition reaction: $BrO_3^- + Br^- \rightarrow Br^- + O_2$ proceeds at a measurable rate in fused $NaNO_3$, KNO_3, or $NaNO_3$-KNO_3 mixtures in the temperature range 340 to 370°. A kinetic study of the reaction showed that the decomposition proceeds by a slow rate-controlling step: $BrO_3^- + Br^- \rightarrow BrO_2^- + BrO^-$ followed by rapid reactions of the intermediates to give the final products. The activation energy for the reaction in molten $NaNO_3$ was determined and the effect of the alkali cation on the reaction rate demonstrated. The effect was interpreted on the basis of the polarizing power of the cation. (auth)

2983 THE NEAR INFRARED TRANSITIONS OF THE TRIVALENT LANTHANIDES IN SOLUTION. I. PRASEODYMIUM(III), NEODYMIUM(III), SAMARIUM(III), AND EUROPIUM(III) IONS. W. T. Carnall, D. M. Gruen, and R. L. McBeth (Argonne National Lab., Ill.). J. Phys. Chem., 66: 2159-64(Nov. 1962). (TID-15855)

The solution absorption spectra of Pr^{3+}, Nd^{3+}, Sm^{3+}, and Eu^{3+} were measured in molten $LiNO_3$-KNO_3 eutectic at 150° in the range 0.35-2.6 μ (28,600-3850 cm^{-1}). New observations of a number of absorption bands in solution in the region 1.40-2.6 μ (7140-3850 cm^{-1}) were made by taking advantage of the optical transparency of the $LiNO_3$-KNO_3 eutectic solvent in this region of the spectrum. Theoretical interpretations of the solution spectra are offered based on recent experimental and theoretical analyses of crystalline salts of the lanthanide ions. (auth)

2984 FUSED SALT SPECTROPHOTOMETRY. III. ISOSBESTIC POINTS GENERATED BY VARIATION IN TEMPERATURE. J. R. Morrey (General Electric Co., Richland, Wash.). J. Phys. Chem., 66: 2169-73(Nov. 1962).

A study of the temperature dependence of fused-salt spectra revealed that several systems produce isosbestic points. As the temperature of a given sample is varied, the corresponding spectra often exhibit several wave lengths at which the absorbance is temperature independent. A phenomenological argument is presented to show that when this happens, one and only one species contributes to the absorbance in the region of an isosbestic point and that this species does not change concentration as a function of temperature because of equilibria involving other non-absorbing species. It also is shown that spectral changes must arise from a linear temperature dependence of the molar absorptivity at a given wave length. These conclusions are in contradistinction to those made by consideration of isosbestic points occurring at constant temperature. In the latter case, their existence proves that two and only two absorbing species are variables. (auth)

2985 THE SECONDARY DEUTERIUM ISOTOPE EFFECT IN THE PYROLYSIS OF DIMETHYLMERCURY. Ralph E. Weston, Jr. and Stanley Seltzer (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 2192-2200 (Nov. 1962). (BNL-6114)

The relative rates of the cyclopentane-inhibited pyrolysis of dimethylmercury and dimethylmercury-d_6 were measured at 366°. The rate constant ratio is $k_D/k_H = 1.072 \pm 0.009$. The inverse isotope effect was attributed to an increase in C–H stretching frequencies of the transition state compared with the normal molecule, while the C–H bending frequencies remained unchanged. Rate constants for the pyrolysis of dimethylmercury at 303–366° were determined, and are in good agreement with values obtained previously. This is also true of the C^{13} isotope effect, which at 366° is $k_{12}/k_{13} = 1.0386 \pm 0.0007$. It was found that methyl radicals did not exchange with dimethylmercury under the conditions of the experiments. (auth)

2986 TRANSFER FREE ENERGIES FOR SOME UNIVALENT CHLORIDES FROM H_2O TO D_2O FROM MEASUREMENTS OF ION EXCHANGE MEMBRANE POTENTIALS. J. Greyson (International Business Machines Corp., New York). J. Phys. Chem., 66: 2218-21(Nov. 1962).

The cells $Ag|AgCl|\underset{H_2O}{MCl\ (a_1)}\|\underset{D_2O}{MCl\ (a_2)}|AgCl|Ag$ with $\|$ representing a cation exchange membrane and M representing the ions Li^+, Na^+, K^+, Cs^+, NH_4^+, and $(CN_3)_4N^+$ were investigated. The emf values showed a spontaneous transfer of salt from D_2O to H_2O. The measurements, combined with published enthalpy data and with additional measurements of systems of H_2O-D_2O mixtures, yielded entropy values which were interpreted according to Frank's iceberg theory. (auth)

2987 MOLECULAR DIMENSIONS AND INTERACTIONS OF LITHIUM POLYPHOSPHATE IN AQUEOUS LITHIUM BROMIDE SOLUTIONS. U. P. Strauss and P. Ander (Rutgers Univ., New Brunswick, N. J.). J. Phys. Chem., 66: 2235-9(Nov. 1962).

The behavior of two lithium polyphosphate samples, having molecular weights of 4.3×10^5 and 5.5×10^5, in aqueous lithium bromide solutions was investigated by means of light scattering and viscosity measurements at 25° in order to obtain a quantitative comparison with the previously studied corresponding sodium polyphosphate–sodium bromide system. The theta solvent, in which the second virial coefficient extrapolated to zero, was 1.80 M LiBr, in contrast to 0.415 M NaBr found previously for the sodium case. The ratio of the theta solvent molecular dimensions to those calculated assuming free rotation about each P–O bond averaged 1.73, in close agreement with 1.68 found in the sodium system. The relationship between the molecular dimensions and the second virial coefficient also was the same for both systems. The dependence of molecular dimensions on ionic strength could be described by Flory's equation: an effective degree of ionization of 0.13 was necessary to reach agreement between theory and experiment. The corresponding value for the sodium system was 0.10. Extrapolation of the data to infinite ionic strength indicated that the sodium polyphosphate has much less solvent affinity than the lithium polymer, a result in agreement with the different theta solvent compositions and previously observed phase separation behavior. It is of interest that at the high LiBr concentrations, selective adsorption of water was so large that correction factors greater than two were needed to obtain the light scattering molecular weights. (auth)

2988 THE COMPOSITION OF ANTIMONY VAPOR. Gerd M. Rosenblatt (Univ. of California, Berkeley). J. Phys. Chem., 66: 2259-60(Nov. 1962).

It is shown that the experimental results of Illarionov and Cherepanova (Proc. Acad. Sci. USSR, Chem. Sect., 133: 901, 1960) on the vapor density of antimony do not contradict the accepted thermodynamic properties of antimony and do not substantiate the conclusions drawn from the results. (P.C.H.)

2989 THE THERMODYNAMICS OF AQUEOUS ELECTROLYTE MIXTURES AT ELEVATED TEMPERATURES. THE SOLUBILITY OF SILVER SULFATE IN $KNO_3-K_2SO_4$, $K_2SO_4-MgSO_4$, AND $K_2SO_4-H_2SO_4$ MIXTURES. M. H. Lietzke and R. W. Stoughton (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 2264-6(Nov. 1962).

The solubility of Ag_2SO_4 was investigated in three electrolyte mixtures: $KNO_3-K_2SO_4$, $K_2SO_4-MgSO_4$, and $K_2SO_4-H_2SO_4$. In each of the three systems the total ionic strength of the solubility medium was held constant at two different values, while the ratio of the two components was varied. Weight concentrations were used in reporting the data, and the Debye-Huckel limiting slope at any temperature was made density dependent by multiplying its value on the molal scale by the square root of the density of water at that temperature. A direct correlation of the solubilities was found to be neither simpler nor more complicated than a correlation through an activity coefficient function. (P.C.H.)

2990 PRELIMINARY STUDY ON THE GROWTH OF LEAD ZIRCONATE-TITANATE CRYSTALS. Takuro Ikeda and Shoichi Fushimi (Nippon Telegraph and Telephone Public Corp., Tokyo). J. Phys. Soc. Japan, 17: 1202-3 (July 1962). (In English)

Some preliminary studies on the growth of lead zirconate-titanate single crystals are reported. The raw materials used were powder specimens prepared by solid state reactions. The compositions of the solid solutions are described as $Pb(Zr_x-Ti_{1-x})O_3$ and the values of x are specified. The KF and KF-PbF_2 solutions were examined. (W.D.M.)

2991 THE INFLUENCE OF ANNEALING TEMPERATURE OF RARE EARTHS METALS ON THEIR CATALYTIC ACTIVITY. L. A. Sazonov and M. G. Logvinenko. Kinetika i Kataliz, 3: 761-6(Sept.-Oct. 1962). (In Russian)

Catalytic properties of CeO_2, Dy_2O_3, Gd_2O_3, La_2O_3, Nd_2O_3, Sm_2O_3, and Yb_2O_3 were studied in relation to CO oxidation, and the temperature dependence of La_2O_3, Dy_2O_3, and Nd_2O_3 catalytic activity was determined. (tr-auth)

2992 ANION-EXCHANGE BEHAVIOR OF NEPTUNIUM IONS IN NITRIC ACID SYSTEM. Ying-Mao Chen (National Taiwan Univ., Japan). Nippon Genshiryoku Gakkaishi, 4: 665-71(Oct. 1962). (In English)

The anion-exchange behavior of Np ions was studied by the use of Np^{239}. Neptunium adsorbed on the column of Dowex-1 resin was eluted with nitric acid. The shape of the resulting curves was studied by changing the experimental conditions of eluting solution and by using an exchanger with different degree of cross linkage. The oxidation states of Np were assigned by coprecipitation tests with sample drops taken from the vicinity of elution peaks. From the position of peaks of the elution curves, K_d values for Np(V) and Np(VI) were calculated. The K_d value of Np(V) shows a second power dependence on the acidity of eluting solution, whereas that for Np(VI) gives first power dependence. Such relationships for Np(V) and Np(VI) coincide with those of Pa(V) and U(VI), respectively. K_d values of actinide ions in the oxidation state of IV increase with increase of atomic number but those of (V) and (VI) give a reverse relation; e.g., the K_d values for Np(V) and Np(VI) are smaller than those of Pa(V) and U(VI), respectively. Np(VI) is eluted out before Np(V) with nitric acid of concentration higher than 6M, but the reverse relations hold for lower concentrations. K_d values give a linear relationship with the degree of cross linkage of the anion exchanger up to 8 when 6M nitric acid was used as eluant. (auth)

2993 INTERACTION ENERGIES OF VACANCIES IN TRANSITION METAL OXIDES WITH LARGE CONCENTRATION OF VACANCIES. M. Hoch, A. S. Iyer, and J. Nelken (Univ. of Cincinnati). Phys. Chem. Solids, 23: 1463-71(Oct. 1962). (In English)

Equations are derived from statistical considerations to obtain vacancy interaction energies, E_{11}, E_{22} (for vacancies with same sign), and E_{12} (with opposite sign), from the variation of oxygen partial free energy with composition for FeO, TiO, and NbO. The oxygen partial free energy was determined through electromotive force measurements with solid electrolytes. Cells of the type Nb, NbO/electrolyte (0·8 ZrO_2-0·2 CaO)/NbO, NbO_2 were studied. The measurements were carried out in vacuum, with tungsten electrodes and induction heating. In FeO, $E_{22} = 2.74 \pm 0.10$ kcal/mole. In TiO, $E_{11} = E_{22} = 2.10 \pm 0.03$ kcal/mole, $E_{12} = -2.97 \pm 0.04$ kcal/mole. In NbO, $E_{11} = E_{22} = 17.9$ kcal/mole, $E_{12} = -25.3$ kcal/mole. The constancy of the vacancy interaction energies permitted the accurate placement of the boundaries of the TiO phase. The entropy of TiO should be increased by 1.68 eu to account for the randomness of vacant titanium and oxygen sites. (auth)

2994 NUCLEAR MAGNETIC RESONANCE AND KNIGHT SHIFT IN SOLID INDIUM. D. R. Torgeson and R. G. Barnes (Ames Lab., Ames, Iowa). Phys. Rev. Letters, 9: 255-7(Sept. 15, 1962). (IS-489)

The observation of the nuclear magnetic resonance of In^{115} in solid polycrystalline indium and the measurement of the Knight shift are reported. The value obtained for the isotropic Knight shift parameter at 300°K is $0.82 \pm 0.04\%$, and the anisotropic contribution is $-0.14 \pm 0.04\%$. Samples of indium prepared by agitating the molten metal in Dow-Corning silicone fluid were investigated. The complete In^{115} spectrum at a frequency of 12.500 Mc/sec is given. The frequency dependence of the splitting of the central transition of the resonance was used to determine the Knight shift parameters. The behavior of the splitting of the central transition of the In^{115} spectrum in solid indium and the directly measured shifts of the high- and low-frequency halves of the transition with respect to the aqueous $InCl_3$ standard resonance at constant magnetic field are plotted. The quadrupole coupling constants were calculated from the high- and low-frequency curves as 29.56 and 29.53 Mc/sec, respectively. (H.D.R.)

2995 MULTICOMPONENT DIFFUSION IN THE SYSTEM $^{85}Kr-He-Kr$. B. N. Srivastava and R. Paul (Indian Assn. for the Cultivation of Science, Calcutta). Physica, 28: 646-52(July 1962). (In English)

The diffusion coefficients of Kr^{85} in trace quantities in mixtures of helium and normal krypton, as well as in pure helium and pure krypton, were determined by using an all-metal apparatus. The apparatus consists of two diffusion chambers joined by a diffusion capillary of special design so that the chambers can be connected or disconnected by a bellows operated piston valve. For analysis one of the chambers has a thin cellophane window with a scintillation counter placed close to it. First both the chambers were filled with the desired gas mixture and then a small amount of Kr^{85} was added to one chamber and the pressures equalized. Diffusion was then started and the counting rate determined at regular intervals, from which the relaxation time and the diffusion coefficient were calculated. The diffusion coefficient $D_{1\to23}$ of Kr^{85} in the mixture of Krypton and helium was found to be accurately given by the theoretically predicted formula: $1/D_{1\to23} = (C_2/D_{12}) + (C_3/D_{13})$ where C_2, C_3 are the concentrations of normal krypton and helium, and D_{12} and D_{13} are the binary diffusion coefficients. As expected, a plot of the experimental values of $1/D_{1\to23}$ against C_3 was found to be a straight line from which D_{12} and D_{13} were calculated. (auth)

2996 PHASE DIAGRAM OF SOLID-LIQUID SYSTEMS FORMED BY HYDROGEN ISOTOPES. V. S. Kogan, B. G. Lazarev, and R. F. Bulatova. Ukr. Fiz. Zh., 7: 732-6(July 1962). (In Ukrainian)

The solid-liquid phase diagram for the hydrogen–deuterium system was studied by x-ray diffraction at 4.2°K and a thermal analysis within a temperature range of 12–20°K. The phase diagram was of the peritectic type with a broad two-phase region (from 10% D_2 to 80% D_2 at 4.2°K). The existence of such a two-phase region in solid solutions of hydrogen isotopes is in good agreement with the results of theoretical calculations. As shown by preliminary data, the same phenomenon occurs in the D_2-HD system. (auth)

2997 DENSITY OF H_2-D_2 MIXTURES. V. N. Grigorev and N. S. Rudenko (Khar'kov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 7: 737-9(July 1962). (In Ukrainian)

The density of the binary system H_2-D_2 was measured by hydrostatic weighing, and the relative excess volume $(\Delta V/V)$ was determined. The measurements were made in the range from the melting points of the mixtures to 20.4°K. For all mixtures $(\Delta V/V) < 0$ and independent of the temperature within limits of experimental accuracy. For an equimolar mixture $(\Delta V/V) \approx -10^{-2}$. Theoretical calculations of $(\Delta V/V)$ for the H_2-D_2 system did not agree with the experimental data. (auth)

2998 DIFFERENCE IN THE SATURATED VAPOUR PRESSURES OF KRYPTON AND XENON ISOTOPES. V. N. Grigorev (Khar'kov Inst. of Physics and Tech.). Ukr. Fiz. Zh., 7: 739-42(July 1962). (In Ukrainian)

Data obtained from a study of the separation of isotopes in a non-packing rectification column were used for evaluating the relative difference in the saturated vapor pressures $(\Delta p/p)$ of Kr and Xe isotopes. At the boiling point of krypton (120°K) $(\Delta p/p) = 4.7 \times 10^{-4}$ for Kr^{82} and Kr^{86} and at the boiling point of xenon (165°K) $(\Delta p/p) = 10^{-4}$ for Xe^{130} and Xe^{136}. Qualitative agreement was found between the experi-

mental data and calculations made according to the quantum theorem of the corresponding states. (auth)

2999 THE COMPOSITION OF URANYL FERROCYANIDES FORMED IN THE PRESENCE OF ORGANIC SOLVENTS. V. D. Ponomarev and I. V. Tananaev (Moscow Inst. of Engineering Physics). Zh. Analit. Khim., 17: 718-20(Sept. 1962). (In Russian)

It is shown that in alcohol solutions (50–60%) a normal uranyl ferrocyanide is formed in the presence of lithium ions and mixed uranyl-alkaline metal ferrocyanides are formed in the presence of other alkaline element ions. In the presence of ethyl alcohol, a regular increase of the alkaline metal content in the mixed uranyl ferrocyanides is observed in comparison with the precipitates separated from aqueous solutions. (auth)

3000 THE STRUCTURE OF COMPLEX NIOBIUM OXALATES. L. G. Vlasov, A. V. Lapitskii, M. A. Salimov, and B. V. Strizhkov. Zh. Neorgan. Khim., 7: 2534-6(Nov. 1962). (In Russian)

Using previously described methods, the following compounds were prepared: $[NH_4]_3[NbO(C_2O_4)_3] \cdot 2H_2O$; $Na_3[NbO(C_2O_4)_3] \cdot 2H_2O$; and $K_3[NbO(C_2O_4)_3] \cdot 2H_2O$. Their structures were determined by x-ray diffraction. Study of the thermal decomposition of the complexes indicated that the K and Na oxalatoniobates behave similarly while the NH_4 compound is quite different. Analysis of the gases escaping during the heating clarified the mechanism of the thermal decomposition which yields orthoniobates as end products; this was confirmed by direct determination with $KMnO_4$. The crystalline hydrates and the water-free compounds of the K and Na system were found to be the most resistant; in the case of the NH_4 compound the mono- and higher hydrates were more resistant and their dehydration was followed by decomposition. The bond strength of the first water molecule was found to be 10 kcal/mole for the NH_4 compound and 14 kcal/mole for the K and Na compounds, indicating that the water is held by crystallization. Infrared spectra of the 3 compounds revealed that the water does not enter into the internal sphere of the complex; as to the oxalate groups, it is considered that one of them is bound in the internal sphere and 2 in the external sphere of the complex according to the following formula: $Me/NbO_2(C_2O_4)/:2MeHC_2O_4 \cdot H_2O$. (TTT)

3001 COMPLEX FORMATION OF INDIUM WITH GALLIC ACID. D. I. Ryabchikov, Ke-min Yao, and I. N. Marov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorgan, Khim., 7: 2545-8 (Nov. 1962). (In Russian)

The composition and the properties of the complexes formed by indium with gallic acid were investigated by means of ion-exchange studies, high-frequency, and potentiometric titration, using In^{114} perchlorate for labeling. The distribution of In between the 0.5 molar $NaClO_4$ and the cationite was determined by a gamma counter in the absence and the presence of gallic acid. Preliminary tests indicated that no soluble complexes are formed in acid medium; therefore the ion-exchange experiments were carried out at pH ≅ 7. It was established that in neutral medium a fairly stable In–Ga compound is formed which is strongly adsorbed on anion-active resins and has a double negative charge. (TTT)

3002 STUDY OF THE INTERACTION OF PRASEODYMIUM CHLORIDE WITH SODIUM AND POTASSIUM CHLORIDES IN MELTS. Z. N. Shevtsova, E. N. Korzina, and B. G. Korshunov (Moscow State Univ.). Zh. Neorgan. Khim., 7: 2596-9(Nov. 1962). (In Russian)

The interaction between $PrCl_3$ and NaCl–KCl is of great interest for the development of treatment methods for ores containing rare earths and for the preparation of metallic Pr by molten bath electrolysis. The co-crystallization method was used for the studies, which involved the determination of cooling curves. The component binaries $PrCl_3$–KCl and NaCl–KCl were previously investigated. The $PrCl_3$–NaCl system was studied under dry HCl atmosphere to prevent the decomposition of the $PrCl_3$. It was found to contain a eutectic at 37 mole % $PrCl_3$ with a melting point of 468 ± 2°C. The ternary system itself was examined in 6 internal sections. The stable K_3PrCl_6–NaCl system contained a eutectic at 18.4% $PrCl_3$, 26.4% NaCl and 55.2% KCl (in mole %), with a melting point of 530 ± 2°C; at 585°C a polymorphic transformation of the compound K_3PrCl_6 takes place. On the basis of the data obtained the phase diagram of the system could be determined: the surface of the liquidus consists of 5 primary crystallization fields, corresponding to the separation of $PrCl_3$, NaCl, KCl, K_2PrCl_5, and K_3PrCl_6 from the melt. (TTT)

3003 THE TERNARY SYSTEM FORMED BY SODIUM, CESIUM AND CADMIUM CHLORIDES. I. I. Il'yasov (Rostov-on-the-Don Branch of the Soviet Commercial Correspondence Inst., USSR). Zh. Neorgan. Khim., 7: 2604-5(Nov. 1962). (In Russian)

Several ternary systems involving alkali metal and cadmium chlorides possess great affinity toward complex formation. This problem was examined by means of thermal analysis of the CsCl–NaCl–$CdCl_2$ system. In the Na_2Cl_2–$CdCl_2$ binary a compound, $CdCl_2 \cdot 2NaCl$, with a melting point of 433°C was found; the transition point is located at 37.5% $CdCl_2$. The Na_2Cl_2–Cs_2Cl_2 system possesses a eutectic at 34% Na_2Cl_2, melting at 493°C. A higher value than previously reported, 495°C, was found for the compound $2CsCl \cdot CdCl_2$ in the Cs_2Cl_2–$CdCl_2$ system. On the basis of the 11 sections investigated in the ternary system, the crystallization regions, the transition points, and the ternary nonvariant points were determined. It is of interest to note that the compound $2NaCl \cdot CdCl_2$ has an exceedingly small crystallization region. Both compounds located toward the Cs_2Cl_2–$CdCl_2$ side retain their congruent nature within the ternary system. (TTT)

3004 MELTING DIAGRAM OF THE SYSTEM CONTAINING LITHIUM AND POTASSIUM PYROPHOSPHATES AND SODIUM FLUORIDE. A. G. Bergman and V. P. Goryacheva (Kuban Agricultural Inst. and Rostov Scientific Research Inst. of Mechanical Engineering, USSR). Zh. Neorgan. Khim., 7: 2617-18(Nov. 1962). (In Russian)

The ternary system formed by the diagonal section of the quaternary system containing the 6 salts Li, Na, K || F, P_2O_7 was investigated, establishing the crystallization surface on the basis of 15 internal sections. The melting diagram contains 3 crystallization areas which converge at the ternary eutectic point at 520°C, composed of 33.3% $Li_4P_2O_7$, 33.5% Na_4F_4, and 33.2% $K_4P_2O_7$. In the region of $K_4P_2O_7$ the isotherms have a convex character and in the region of the other 2 components a concave character. The data indicate that the system represents a quasi-ternary stable diagonal of the quaternary, dividing the composition prism into the stable tetrahedron $Li_4P_2O_7$–$Na_4P_2O_7$–$K_4P_2O_7$–Na_4F_4 and the pentahedron Li_4F_4–Na_4F_4–K_4F_4–$Li_4P_2O_7$–$K_4P_2O_7$; the latter was partially studied. The above mentioned ternary eutectic point lies 132°C below the melting point of the $Li_4P_2O_7$–$Na_4P_2O_7$–$K_4P_2O_7$ eutectic lying on the bottom of the prism. This low-melting mixture may find a practical application. (TTT)

3005 THE STABLE INTERSECTING TETRAHEDRON OF THE Na^+, K^+, Ca^{2+}, Ba^{2+}; F^-, Cl^- SYSTEM. G. A.

Bukhalova and G. N. Maslennikova. Zh. Neorgan. Khim., 7: 2619-26(Nov. 1962). (In Russian)

In order to be able to formulate flux compositions used for the preparation and welding of nonferrous and light metals, the phase diagrams of mixtures consisting of the salts Na^+, K^+, Ca^{2+}, Ba^{2+} || F^-, Cl^- must be known. In the binary systems 6 double-salt type complexes are formed. The phase diagram of the system is divided by numerous tetrahedral sections into several pentahedra as the result of the presence of compounds. One of the stable tetrahedral sections which has a quaternary character and consists of the 6 ions $Na_4Cl_4-K_4Cl_4-Ca_2F_4-BaF_2 \cdot BaCl_2$ was more closely investigated. The results of thermal analysis indicated that in view of the formation of a continuous series of solid solutions by NaCl and KCl, there are only 3 crystallization regions in the system: those formed by CaF_2, the $BaF_2 \cdot BaCl_2$ complex, and the NaCl–KCl solid solutions. The lowest ternary point corresponding to equilibrium conditions of the above phases lies at 620°C with the composition 47% Na_4F_4, 40.3% K_4F_4, 12% $BaF_2 \cdot BaCl_2$, and 0.7% Ca_2F_4. (TTT)

3006 MIXED AMMONIUM–SODIUM OXALATE COMPOUNDS OF URANYL AND URANIUM (IV). N. N. Elovskikh and K. T. Rumyantseva. Zh. Neorgan. Khim., 7: 2639-40(Nov. 1962). (In Russian)

Dissolving uranyl oxalate in a 1:1, concentrated Na + NH_4 oxalate solution the easily crystallized ammonium sodium uranyl trioxalate trihydrate $(NH_4)_2Na_2[UO_2(C_2O_4)_3] \cdot 3H_2O$ was precipitated. The reaction follows the equation $UO_2C_2O_4 + (NH_4)_2C_2O_4 + Na_2C_2O_4 = (NH_4)_2Na_2[UO_2(C_2O_4)_3]$. The solubility of the salt on the basis of U was found to be ~45 g/l; stable solutions were obtained. Interaction of U(IV) oxalate solution with Na + (NH_4) oxalates in 1:1:1 stoichiometric ratio yielded a strongly opalescent solution which upon evaporation yields isometric crystals and fine crystalline aggregates; both have the same indices of refraction Ng = 1.561 ± 0.015; Np = 1.551 ± 0.015. The formula of the compound was found to be: $(NH_4)_2Na_2[U(C_2O_4)_4] \cdot 6H_2O$ with a solubility of about 179 g/l of uranium. (TTT)

3007 HEAT OF DISSOLUTION OF URANYL NITRATE IN AQUEOUS NITRATE SOLUTIONS. O. Ya. Samilov and V. I. Yashkevich (Kurnakov Inst. General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Strukt, Khim., 3: 143-50(Mar.-Apr. 1962). (In Russian)

The heats of dissolution of uranyl nitrate in aqueous salting-out solutions (Na, K, Mg, Ca, Sr, Cd, Ni, and Co nitrates) were determined at 10, 15, 25, and 35°C. A model describing the dependence on the electrolyte concentration was developed. (tr-auth)

3008 CRYSTAL STRUCTURE OF POTASSIUM TETRANITROHYDROXY-NITROSORUTHENITE $K_2[RuNO(OH)(NO_2)_4]$. G. B. Bokii, Aug-nu Wang, and T. S. Khodashova (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Strukt. Khim., 3: 163-72(Mar.-Apr. 1962). (In Russian)

An x-ray diffraction analysis of $K_2[RuNO(OH)(NO_2)_4]$ showed for the face projection $P2_1/a$, a = 12.46, b = 12.41, c = 7.07 Å, and $\beta = 92°46'$. The decoding was carried out according to Paterson projection and electron density. The nitrogen-oxygen coordinates in the nitroso- and hydroxy-groups were verified by projecting differences in electron densities. The NO and HO groups in octahedral complex ions, $[RuNO(OH)(NO_2)_4]^{2-}$, are distributed in transposition. The Ru–N–O grouping is nonlinear with an angle ≈170°. The distance Ru–NO = 1.85 Å is considerably smaller than the similar distance for the central atom of the nitro group (Ru–NO_2 ≈ 2.1 A). It is postulated that Ru and nitroso-groups have a binary bond. (tr-auth)

3009 X-RAY L_{II} AND L_{III} ABSORPTION SPECTRA OF RARE EARTHS IN OXIDES AND HEXABORIDES. PART I. Ba, La, AND Ce ABSORPTION SPECTRA. E. E. Vainshtein, I. B. Staryi, S. M. Blokhin, and Yu. B. Paderno (Inst. of Inorganic Chemistry, Siberian Dept. of the Academy of Sciences, USSR). Zh. Strukt. Khim., 3: 200-7(Mar.-Apr. 1962). (In Russian)

Experimental studies and calculations were made of the L_{II} and L_{III} x-ray absorption spectra of Ba, La, and Ce in oxides and hexaborides. The results are used for determining the ionic charge and the interatomic interaction in the compounds. (tr-auth)

3010 IONIZATION POTENTIALS AND HEATS OF FORMATION OF COMPOUNDS. I. N. Maksimova (Leningrad Inst. of Tech.). Zh. Strukt, Khim., 3: 208-10(Mar.-Apr. 1962). (In Russian)

The temperature dependence of chloride, oxide, sulfide, and nitrate formation on the relative variations of the ionization potential at a given ionic transition, $t_w = (I_{w+1} - I_w)/I_w$, was analyzed. Postulation that a higher exothermic reaction corresponds to larger t_w (in identical compounds) holds for all compounds except carbon compounds. The curves of ΔH^0_w for chloride elements of the 4, 5, 6, and 9 series were constructed as functions of t_w. Chloride-oxide t_w and ΔH^0_{rev} relation for various groups and periodic series are analyzed. (R.V.J.)

Organic Chemistry

Refer also to abstracts 2708, 2709, 2710, and 2711.

3011 (BNL-5458) SECONDARY α-DEUTERIUM ISOTOPE EFFECTS AND STRUCTURES OF TRANSITION STATES. Max Wolfsberg, Stanley Seltzer, and Robert S. Freund (Brookhaven National Lab., Upton, N. Y.). [1961]. Contract [AT(30-2)-Gen-16]. 6p.

Secondary α-deuterium isotope effects in the solvolysis of cyclopentyl-1-d-p-toluenesulfonate are explained in terms of a change in the H-C-leaving group force constant. The transition state geometry cannot be determined directly. (R.J.S.)

3012 (IA-742) ORGANIC LIQUID SCINTILLATORS. PART IV. COMPUTATION OF EFFICIENCIES OF ORGANIC LIQUID SCINTILLATORS. Adam Heller (Israel. Atomic Energy Commission, Rehovoth). Aug. 1962. 32p.

The results of the computation of the scintillation and fluorescence properties of 22 aromatic conjugated systems are presented. Some of these are expected to have superior properties to those in use at present. A new scintillation solute, 1,4-bis-(p-isopropylstyryl)–benzene, when used as a secondary solute in a p-terphenyl solution in xylene, has an efficiency higher than 80% on the anthracene scale. (auth)

3013 (TID-17263) THE SCINTILLATION PROPERTIES OF COORDINATION COMPOUNDS. Final Scientific Report through the Period Ending June 30, 1962. R. N. Keller (Colorado. Univ., Boulder). Contract AT(11-1)-261. 14p.

Use was made of organic scintillator solutions to study fluorescent emission. A considerable fluorescence intensity was present in the pure solute and solutes at high concentrations. Pulse-height measurements were made in a system free from oxygen. Complex quenching effects of oxygen were observed. Several unsuccessful attempts were made to obtain ultraviolet emission spectra under conditions identical to those for the pulse-height measurements. (M.C.G.)

3014 (TID-17309) THE SYNTHESIS OF ORGANO-LANTHANIDE DERIVATIVES. Sixth Quarterly Progress Report, Period Ending August 15, 1962. (Ethyl Corp. Research and Development Div., Detroit). Contract AT(11-1)-999. 8p.

The cyclopentadienyl dichlorides of dysprosium and lutetium were prepared and isolated as the tristetrahydrofuranates. Magnetic susceptibility measurements on the dicyclopentadienyllanthanide chlorides show that the central lanthanide is formally in the tripositive state for the elements studied which include Sm, Gd, Dy, Ho, Er, Yb, and Lu. The magnetic moments of the cyclopentadienyllanthanide dichlorides of Eu, Dy, Er, and Yb are also characteristic of a tripositive central lanthanide. Tricyclopentadienyleuropium was prepared for the first time and was isolated in the form of a monotetrahydrofuranate. A molecular weight measurement on di(methylcyclopentadienyl)erbium acetate in benzene, revealing it to be a dimer, indicates that the acetate ion probably partakes in bridge-type bonding. A series of initial unsuccessful attempts was made to prepare a carbonyl derivative of uranium. (auth)

3015 (WADD-TR-61-72(Vol. X)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME X. THERMAL REACTIVITY OF AROMATIC HYDROCARBONS. I. C. Lewis and T. Edstrom (National Carbon Co. Research Lab., Parma, Ohio). May 1962. Contract AF 33(616)-6915. 41p.

A general survey is given of the thermal reactivity of aromatic hydrocarbons to provide information basic to the understanding of the conversion of organic materials to carbon. Differential thermal analysis was employed on 84 aromatic hydrocarbons to delineate the thermal sequences during pyrolysis to 750°C. Absorption spectra, electron spin resonance, chromatography, and molecular weight determinations were used to determine the mechanisms and structural changes which occur. (auth)

3016 HIGH-KINETIC ENERGY FRAGMENT IONS FROM ALIPHATIC HYDROCARBONS UNDER ELECTRON IMPACT. I. MEASUREMENT AND HIGH-KINETIC ENERGY METHYL IONS FROM 1,3-BUTADIENE. Toshikazu Tsuchiya (Government Chemical Industrial Research Inst., Tokyo). Bull. Chem. Soc. Japan, 35: 1221-6(July 1962). (In English)

A conventional analytical mass spectrometer was used to study methyl ions with excess kinetic energy produced from six hydrocarbons: ethane, propane, n-butane, iso-butane, propylene, and 1,3-butadiene. An appreciable part of the m/e = 15 ions of 1,3-butadiene had excess kinetic energy and is explained with a mechanism in which a H atom is transferred from the second C atom to the first C atom in the molecule and the resulting CH_3 group is dissociated. Studies of the ions from ethylene on the basis of the Hustrulid-Mohler assumption show that the mechanism is complicated. (D.L.C.)

3017 THE PRODUCTION OF ORGANIC COMPOUNDS LABELLED WITH C^{14} OR TRITIUM. J. R. Catch (Radiochemical Centre, Amersham, Bucks, Eng.). Chem. Ind. (London), 380-1(Mar. 3, 1962).

The synthesis of drugs and metabolites, starting with $C^{14}O_2$ and H_2^3O, for use in biological and medical investigations is discussed. (H.H.D.)

3018 A SECONDARY INTERACTION OF TRI-n-OCTYLAMINE WITH HYDROCHLORIC ACID AND THENOYLTRIFLUOROACETONE. Leonard Newman and Paul Klotz (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 2262-4(Nov. 1962). (BNL-6100)

The extraction of HCl by benzene solutions of thenoyltrifluoroacetone (TTA) and tri-n-octylamine (TNOA) was studied. The nature of the compound in the organic phase which causes a greater withdrawal of acid from the aqueous phase than predicted by the known reactions was investigated. It was found that the extraction of HCl can be completely accounted for by the presence of three species, R_3NHCl, R_3NHT, and $R_3NHClHT$. (P.C.H.)

3019 FLUID, ORGANIC HEAT-TRANSFER MEDIUM FOR NUCLEAR REACTORS. H. Marinus Penning and Martinus Kolijn (to Shell Internationale Research Maatschappij N. V.). German Patent DAS 1,131,334. "Priority date Sept. 5, 1958 Holland."

A method is given for preparing a fluid, organic heat-transfer medium, which is enriched in aromatics for nuclear reactors. The method comprises the catalytic cracking of gas oil, subjecting it to a catylytic refining with hydrogen as a catalyst, and finally to a solvent extraction. It was found that subjecting the gas oil to the refining before the solvent extraction not only depletes sulfur and nitrogen but renders it extremely resistant to radiation. The medium is also applicable as a moderator. (H.K.)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 2742, 2744, 2749, 2779, 3686, 3687, 3838, and 3901.

3020 (ARL-62-426) THEORETICAL STUDIES IN BASIC RADIATION CHEMISTRY. M. Vestal, A. L. Wahrhaftig, and W. H. Johnston (Johnston (William H.) Labs., Inc., Baltimore). Aug. 1962. Contract AF33(616)-7638. 180p.

Studies concerned with the problem of specifying the distribution of excited ions and molecules formed in gas phase radiation chemical systems were carried out. The principal emphasis was placed on developing and improving a satisfactory theory of unimolecular reactions of excited polyatomic molecule-ions; establishing the validity of the theory by comparing calculated results with published experimental data; and extending the theory for application to radiation chemistry. Consideration was also given to the problem of specifying the electron energy distribution producing the excitation and ionization in an irradiated gas phase system. Theoretical results are presented for propane, n-butane, and iso-butane. These results include theoretical breakdown graphs, mass spectra, and ionization efficiencies. The effects on the unimolecular decay kinetics of fluctuations of energy between charged and neutral fragments, thermal energy, and electron energy distribution are included. (auth)

3021 (BNL-5454) A SIMPLE DEVICE FOR MILKING HIGH-PURITY Y^{90} FROM Sr^{90}. R. F. Doering, W. D. Tucker, and L. G. Stang, Jr. (Brookhaven National Lab., Upton, N. Y.). [1961]. Contract [AT(30-2)-Gen-16]. 16p.

The Brookhaven Y^{90} generator supplies a high yield of Y^{90} with a Sr^{90} contamination consistently below 10^{-5} μc per ml. Design and operation of the generator are described. (R.J.S.)

3022 (BNL-6407) A REVIEW OF THE PRODUCTION OF "SPECIAL" RADIOISOTOPES. Louis G. Stang, Jr. (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 67p.

Unusual techniques for producing radioisotopes in re-

actors are discussed. The status of reactor-produced radioisotopes at Brookhaven National Laboratory is summarized. (R.J.S.)

3023 (BNL-6510) BROOKHAVEN CHEMONUCLEAR IN-PILE RESEARCH LOOP. Revised Design Summary. Meyer Steinberg, Walter Tucker, Charles Waide, and Paul Bezler (Brookhaven National Lab., Upton, N. Y.). Oct. 1962. Contract [AT(30-2)-Gen-16]. 55p.

The design of a loop for investigating chemonuclear reactions under flow conditions is described. It was designed to handle gaseous systems in conjunction with fixed packages of solid fuel. Loop process conditions, loop component design, in-line analysis section, shielding estimates, process control and instrumentation, equipment layout, final disassembly, and hazards are discussed. (M.C.G.)

3024 (NYO-10143) RESEARCH ON APPLICATIONS OF KRYPTON 85. Quarterly Progress Report No. 3, April 1, 1962–June 30, 1962. W. G. Marancik and P. S. Minetti (Air Reduction Co., Inc. Central Research Labs., Murray Hill, N. J.). Contract AT(30-1)-2906. 9p.

Work was continued on graft polymerization induced by radiation from krypton-85. The experimental conditions required for the polymerization of chlorotrifluoroethylene on natural rubber, and of acrylonitrile on polyethylene film were investigated. Krpton-85 was also used to induce polymerization of vinyl acetate. The reaction was carried out in the vapor phase at 1 atm. A 95% yield was obtained. Its physical properties are being evaluated. Radiation-induced polymerization of acetylene was carried out at high pressure. The physical properties of this polymer are also being evaluated. (auth)

3025 (RFP-278) ALPHA STANDARD SOURCE PREPARATION. Sam Hammons, Jr. (Dow Chemical Co. Rocky Flats Plant, Denver). [1962]. Contract AT(29-1)-1106. 14p.

Procedures for preparation and instrumentation of alpha standards for use in calibrating electronic alpha instruments are listed and discussed. (auth)

3026 (TID-17250) EFFECTS OF HIGH DENSITY IONIZING RADIATION ON COLLOIDAL SYSTEMS AND SUSPENSIONS. Quarterly Technical Status Report No. 2, June 1, 1962 to August 31, 1962. Werner N. Grune, Walter H. Burrows, and Clyde Orr, Jr. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Sept. 10, 1962. Contract AT(38-1)-202. 31p.

Several methods for preparing suitable sols were used with moderate success. The methods used were selected on the basis of various favorable sol characteristics obtainable. A ferric oxide sol was prepared by oxidizing ferric chloride with boiling water. Portions of the resulting sol were then dialysed for varying periods of time. The result of dialysis was a difference in particle size and sol stability upon dilution. A silver iodide sol exhibiting excellent stability but very small particle size (about 1 μ diameter) was prepared. The problem of small particle size was overcome by preparing sols containing excess I^- or excess Ag^+, since it was observed that particle size was dependent on the excess I^- or Ag^+ concentration. Qualitative observation of the electrophoretic mobility of the sols was studied to examine the reliability of equipment. Particles of about 2 μ were found most suitable since the cell construction presently deemed necessary limits the examination of smaller particles. A variety of aerosols was prepared and studied including polymethylmethacrylate, sodium chloride, ammonium sulfate, naphthalene, and stearic acid. Carefully controlled concentrations and spraying conditions yielded particulates of approximately 1 μ or less in diameter. It was found that solvents used in the production of the aerosols contribute significantly to its composition, hence it is necessary to establish behavior due solely to the solvent and its inherent contaminants. Experiments with polymethylmethacrylate aerosol indicated that x radiation resulted in the loss of detectable charging. This was confirmed by further modifications of the experimental apparatus. In the cases of sodium chloride and ammonium sulfate aerosols, electron micrographs of samples collected on the walls of the conduits carrying the aerosols, following their exposure to the x-ray beam, showed insignificant particle deposition. Hence, almost complete discharging was apparently the only effect. In contrast, naphthalene and glycerine aerosols exhibited substantial charging effects when exposed to x radiation. These aerosols normally have small residual charges but exposure to x radiation greatly increased the charge both positively and negatively. A study was made of the effects of radiation on the filterability of glycerine and barium sulfate aerosols. Various methods for preparing foams of uniform bubble size and high stability were examined. The foams produced were collected in graduated tubes and examined for stability by measuring their drainage rates, densities, and bubble sizes. A modification of a similar tube is being prepared for irradiation studies in the Cs^{137} research irradiator. Emulsions of mineral oil in water were produced utilizing a wide variety of surfactants and peptizing agents. Of prime consideration was the desirability of producing a stable emulsion with a minimum of emulsifying agent. Emulsions thus produced were studied at pH values ranging from 1.75 to 9.82, and relationships of settling rate to pH were observed. Methods for observing the samples before and after irradiation were devised. (auth)

3027 (TID-17273) SOLID STATE POLYMERIZATION INITIATED BY GAMMA RADIATION. Progress Report. Herbert Morawetz, Benjamin Post, Jerome Lando, Nicholas Morosoff, and Stephen Jakabhazy (Brooklyn. Polytechnic Inst. Polymer Research Inst.). Oct. 25, 1962. Contract AT(30-1)-1715. 33p.

The thermally initiated polymerization of p-benzamidostyrene was investigated. It was demonstrated that the monomer may be polymerized in the crystalline state to yield an ordered polymer. The reaction seemed to be initiated at the 001 surface and to proceed one layer at a time to deeper lying regions of the crystal. The structure of vinyl stearate was studied. Two models were developed. The structure of polyoxymethylene prepared from single crystal of trioxane was determined. The crystal structures of calcium acrylate dihydrate and barium methacrylate dihydrate proposed previously were further refined. (M.C.G.)

3028 (AEC-tr-5377) YIELD OF RADIOLUMINESCENCE OF ORGANIC MATTERS. Z. A. Chizhikova. Translated from Trudy Fiz. Inst., Akad. Nauk S.S.S.R., Fiz. Inst. im. P. N. Lebedeva, 15: 178-229(1961). 73p.

The luminescence of organic materials excited by gamma rays and alpha particles was investigated. The portion of the energy of the particle which is transformed into luminescence was determined. A survey is presented on studies of radioluminescence. The absolute energetic yield of the photoluminescence of several organic crystals, representing typical scintillators, was determined. Data are presented for stilbene crystals. The corresponding yields of radio- and photoluminescence of several organic crystals were compared, and the values of excitation effectiveness were determined. The relation between lumi-

nescence and the Vavilov-Cherenkov radiation under the influence of the same electrons was studied, and, using the Vavilov-Cherenkov luminescence as reference, the excitation effectiveness of molecules giving off luminescence was determined. Data on the dependence of yield on particle energy and on α/β ratios are presented. It is shown that within the limits of experimental error the ratios of radio- and photoluminescence yields are identical. The results indicate that the yield in case of excitation by weakly ionizing particles is determined by the specific nature of excitation of the radioluminescence and not by the extinction process. (M.C.G.)

3029 NEUTRON IRRADIATION OF ACETOXIME AND ACETALDOXIME. Enzo Tachikawa and Gen-ichi Tsuchihashi (Japan Atomic Energy Research Inst., [Tokyo]). Bull. Chem. Soc. Japan, 35: 957-61(June 1962). (In English)

Degradation of the products obtained from the neutron irradiation of acetoxime shows that the distribution of carbon-14 activity deviates a little from the statistical behavior on account of steric and other effects. However, the yields of "synthesis" product are found to be proportional to the number of hydrogen atoms available for their formation. Also, there seems to be a linear relationship between the yields of "re-entry" or "synthesis" products and the number of atoms available for formation. The present results suggest that the main process forming the "synthesis" products is simple methylation by C^{14}-methyl or C^{14}-methylene radicals, while that giving the "re-entry" products is a "knock on" reaction of carbon-12 by carbon-14. (auth)

3030 RADIATION-INDUCED POLYMERIZATION OF α-METHYLSTYRENE. II. REPLY TO THE CRITICISM OF BATES ET AL. Kozo Hirota and Fukuo Takemura (Osaka Univ.). Bull. Chem. Soc. Japan, 35: 1037-9(June 1962). (In English)

Gamma-ray-induced polymerization of α-methylstyrene occurs mostly according to the radical mechanism, as had been concluded by one of the present authors, but simultaneously it occurs to some extent according to the cationic mechanism, as had been asserted by Bates et al. (auth)

3031 HOT-ATOM CHEMISTRY OF ARSENATES—EFFECT OF CATION, WATER OF CRYSTALLIZATION AND IRRADIATION TEMPERATURE ON THE RETENTION OF RADIOARSENIC IN NEUTRON-IRRADIATED SOLID ARSENATES. Nobufusa Saito and Isao Tomita (Tokyo Univ.). Bull. Chem. Soc. Japan, 35: 1127-30(July 1962). (In English)

The effects of variables on retention of arsenic(V) were studied in arsenates of Li, NH_4, Na, K, Co(II), and Ba, using thermalized neutrons. For $Na_2HAsO_4 \cdot 7\ H_2O$, storage at -72 and -196°C after irradiation had little effect on the retention, while storage at room temperature showed a gradual increase in the retention with time. Solutions of arsenate or arsenic acid irradiated at various pH's gave retentions independent of pH. A significant dependence of retention on irradiation temperature was found for Li_3AsO_4 and $H_4As_2O_7$. No regularity was found in the cation effects on the retention of different arsenates. (D.L.C.)

3032 THE RADIATION-INDUCED OXIDATION OF STANNOUS CHLORIDE IN AQUEOUS HYDROCHLORIC ACID. Ken'ichi Sugimoto and Shigeru One (Radiation Center of Osaka Prefecture, Osaka). Bull. Chem. Soc. Japan, 35: 1159-63(July 1962). (In English)

The radioinduced oxidation of stannous to stannic ions in aqueous HCl was studied for possible use in chemical dosimetry. The amount of oxidation is proportional to the energy absorbed; the yield of stannic ions is independent of dose rate and initial stannous chloride concentration but increases when the stannic concentration is high or oxygen is present. The results are interpreted to mean that the stannic ion is oxidized only by OH radicals. This system can be used for a chemical dosimeter having 8% reproducibility. (D.L.C.)

3033 STUDY OF THE TRANSFORMATIONS OF FREE RADICALS IN γ-IRRADIATED POLYISOPRENES. A. S. Kuz'minskii, M. B. Neiman, T. S. Fedoseeva, Ya. S. Lebedev, A. L. Buchachenko, and V. F. Chertkova (Scientific Research Inst. of the Rubber Industry, Academy of Sciences, USSR and Inst. of Physical Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 146: 611-14 (Sept. 21, 1962). (In Russian)

The nature and the kinetic properties of the free radicals formed in cis- and trans-polyisoprene exposed to γ-radiation of a Co^{60} source were investigated; the kinetic studies were carried out in the trans form which facilitates the capture of free radicals. The electron paramagnetic resonance spectra were obtained from the first derivative of the absorption curve of the irradiated polymers; concentration variations were determined from the amplitude changes of this function. Irradiation of the trans-polyisoprene at room temperature in vacuum to doses ranging from 10 to 150 Mrad resulted in the formation of stabilized free radicals. In the same dose range the number of cross linkages was found to increase with increasing dose while the destruction rate of the free radicals decreased as the density of the space lattice increased. The decomposition may be expressed by a second order equation. Irradiation at -196°C yielded a higher concentration of free radicals than at room temperature. The method opens up possibilities for investigating the formation, decomposition, and capture of free radicals in polymers. (TTT)

3034 THE DEHYDRATION OF ISOPROPYL ALCOHOL BY RADIOACTIVE TRICALCIUM-PHOSPHATE AS A CATALYST. Vikt. I. Spitsyn, A. A. Balandin, I. E. Mikhailenko, and N. P. Dobrosel'skaya (Inst. of Physical Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 146: 1128-31(Oct. 11, 1962). (In Russian)

Radioactive $Ca_3(PO_4)_2 \cdot H_2O$ samples of catalysts containing Ca^{45} (E_{max} = 0.255 Mev) and P^{32} (E_{max} = 1.707 Mev) were prepared. At a specific activity of 6.2 mC of Ca^{45} per gram of catalyst, the conversion of isopropyl alcohol to isopropylene was a little less than the conversion obtained with a non-radioactive catalyst. The conversion increased at a specific activity of 14.6 mC/g, and was a factor of 5 greater with a specific activity of 58.1 mC/g, as compared to the non-radioactive catalyst. The behavior of the catalyst containing P^{32} was analogous to that of the catalyst containing Ca^{45}. With a specific activity of 52.2 mC of P^{32} per gram of catalyst, an eight-fold increase in catalytic activity was observed as compared to the non-radioactive catalyst. On aging the catalyst for 50 days before use, the catalytic activity fell off somewhat. The surface area of the radioactive samples, as measured by krypton absorption, was not changed by addition of radioactivity to the catalyst. The apparent activation energy for the deyhdration reaction is 17.8 kcal/mol with a non-radioactive catalyst. The apparent activation energy is 11.9 kcal/mol at 58.1 mC of Ca^{45} per gram of catalyst, and 7.3 kcal/mol at 52.2 mC of P^{32} per gram of catalyst. (TTT)

3035 THE DECOMPOSITION OF CHLOROACETIC ACID IN AQUEOUS SOLUTIONS BY ATOMIC HYDROGEN. I. COMPARISON WITH RADIATION CHEMICAL DATA.

Joshua Jortner and Joseph Rabani (Hebrew Univ., Jerusalem). J. Phys. Chem., 66: 2078-81(Nov. 1962).

The decomposition of aqueous solutions of chloroacetic acid in acid and neutral solutions by H atoms was investigated. The rate constants for hydrogen and chloride abstraction from the chloroacetic acid and from the chloroacetic anion by H atoms were derived. It was found that H atoms as such react with chloroacetic acid mainly by hydrogen abstraction. The comparison of the results with radiation chemical data yielded evidence for the nature of the reducing radicals produced in the radiolysis of water. The acid form of the reducing radicals involves the H atom as such. (auth)

3036 THE DECOMPOSITION OF CHLOROACETIC ACID IN AQUEOUS SOLUTIONS BY ATOMIC HYDROGEN. II. REACTION MECHANISM IN ALKALINE SOLUTIONS. Joshua Jortner and Joseph Rabani (Hebrew Univ., Jerusalem). J. Phys. Chem., 66: 2081-4(Nov. 1962).

The reactivity of atomic hydrogen in alkaline solutions of chloroacetic acid was investigated. The pH and concentration dependence yield kinetic evidence for the formation of H_2O^- in alkaline solutions: $H + OH^- \rightarrow H_2O^-$ with $k_{H+OH^-} = 6 \times 10^9$ l mole^{-1} sec^{-1}. The results are correlated with radiation chemical data, and the nature of the H_2O^- radical is discussed. (auth)

3037 γ-IRRADIATION OF AQUEOUS SOLUTIONS OF Fe(II)-HYDRAZINE. R. W. Ahrens (E. I. du Pont de Nemours and Co., Aiken, S. C.). J. Phys. Chem., 66: 2108-11(Nov. 1962).

Gamma induced oxidation of Fe^{2+} in 0.4 M H_2SO_4 in the presence of oxygen was inhibited by hydrazine. The decrease in Fe^{3+} yield due to hydrazine was greatest at the highest dose rates. The results are explained quantitatively by the assumption that hydrazine reacts with OH radicals to form hydrazyl radicals, which either oxidize Fe^{2+} or combine to form ammonia. At a dose rate of 2×10^6 rad/hr about 90% of the hydrazyl radicals reacted to form ammonia. (auth)

3038 SOME EFFECTS OF IONIZING RADIATION ON FLUOROCARBON LIQUIDS. Richard F. Heine (Minnesota Mining and Mfg. Co., St. Paul). J. Phys. Chem., 66: 2116-18(Nov. 1962).

The effects of γ radiation on three perfluorinated liquids, C_8F_{18}, c-$C_8F_{16}O$, and $(C_4F_9)_3N$ were studied. Radioinduced changes in physical properties and structure were determined. The results show the stability of the fluorocarbons toward radiation to be greater than that of the analogous hydrocarbons. (auth)

3039 CHARGE TRANSFER IN THE RADIOLYSIS OF ORGANIC LIQUIDS. I. EVIDENCE FROM HYDROGEN GAS YIELDS. T. J. Hardwick (Gulf Research and Development Co., Pittsburgh). J. Phys. Chem., 66: 2132-8(Nov. 1962).

Hydrogen gas yields from the radiolysis of mixtures of saturated hydrocarbons do not necessarily follow a law of averages ($G_{H2} = \Sigma$ electron fraction $\times G_{H2(0)}$), but may be greater or smaller than the predicted value. This effect is believed to result from a charge exchange occurring on collision between the parent positive ion and a neighboring molecule of lower ionization potential. Subsequent charge neutralization results in the decomposition of a different molecule than that which absorbed energy. Not all molecules which can decompose can transfer energy in this fashion; those which cannot transfer energy are considered to be electronically excited. On the assumption that charge transfer occurs during the interval between ionization and charge neutralization, it can be determined that the lifetime of the charge pair is about 4×10^{-13} sec in alkane solvents. (auth)

3040 A KINETIC STUDY OF TELOMER PRODUCTION FROM CHLOROFORM-ETHYLENE MIXTURES INITIATED BY COBALT-60 γ-RADIATION. F. W. Mellows and Milton Burton (Univ. of Notre Dame, Ind.). J. Phys. Chem., 66: 2164-8(Nov. 1962).

Radiolysis of chloroform-ethylene mixtures in an autoclave produced the addition compounds $C_2H_3CCl_3$, $C_4H_9CCl_3$, and $C_6H_{13}CCl_3$ with G-values as high as 3000 at 100° and 300 at 28°. A study of product distribution as a function of ethylene pressure yields transfer constants for the radicals involved in the chain reaction: at 28° the values for the radicals $C_2H_4CCl_3$, $C_4H_8CCl_3$, and $C_6H_{12}CCl_3$ were 0.21, 1.3, and 1.5, respectively; at 100° they decreased to 0.15, 0.54, and 0.45. A study of the chloroform-carbon tetrachloride-ethylene system using both high energy radiation and thermal decomposition of benzoyl peroxide as initators confirmed that the radioinitiated chain reaction is radical, and not ionic, in nature. The effect of non-polar solvents on the transfer constants suggests that increase in transfer constants with increasing chain length is a result of a decrease in rate of the radical-olefin addition reaction. G-values for pure carbon tetrachloride-ethylene mixtures were not determined, but indirect evidence indicates G(telomer) of the same order as those obtained with chloroform. (auth)

3041 IODINE PRODUCTION IN THE γ-RADIOLYSIS OF CYCLOHEXANE-ALKYL IODIDE SOLUTIONS. Thomas S. Croft and Robert J. Hanrahan (Univ. of Florida, Gainesville). J. Phys. Chem., 66: 2188-92(Nov. 1962).

Iodine production induced by γ radiolysis was measured for solutions of methyl iodide in cyclohexane and ethyl iodide in cyclohexane, over the concentration range 0-95% cyclohexane by volume. In each case the addition of cyclohexane caused a smooth decrease in iodine production from the alkyl iodide, but net iodine production persisted until at least 93 electron % cyclohexane was added. The observations are discussed in terms of a previously proposed mechanism. (auth)

3042 DEUTERIUM ISOTOPE EFFECTS IN THE PHOTOCHEMICAL EVOLUTION OF HYDROGEN FROM AQUEOUS FERROUS SOLUTIONS. Joshua Jortner and Gabriel Stein (Hebrew Univ., Jerusalem). J. Phys. Chem., 66: 2200-4(Nov. 1962).

The dependence of the isotope separation factor in the photochemical evolution of hydrogen from aqueous solutions of ferrous sulfate on the concentration of H^+, ferrous, and ferric ions and on the concentration of an organic scavenger (methanol) was investigated. The results were interpreted in terms of a consecutive mechanism involving isotope separation in each of two steps. The respective separation factors in the first step (leading to H atom formation) and in the second (involving oxidation of Fe^{2+} by H) were derived. Isotope effects in radiation and photochemistry were compared. The isotope separation factors obtained support the intermediate hydride formation mechanism for the oxidation of Fe^{2+} by H atoms. (auth)

3043 MECHANISM OF THE DECOMPOSITION OF INORGANIC NITRATES. Tung-ho Chen and Everett R. Johnson (Stevens Inst. of Tech., Hoboken, N. J.). J. Phys. Chem., 66: 2249-53(Nov. 1962).

The radioinduced decomposition of several inorganic nitrates was studied at room temperature. It was found that the experimental results are compatible with the simple kinetic scheme, $MNO_3 \rightarrow MNO_2 + O$; $O + MNO_3 \rightarrow O_2 + MNO_2$; $O + MNO_2 \rightarrow MNO_3$, for all the nitrates studied except silver nitrate. (auth)

3044 THE PHOTOLYSIS AND RADIOLYSIS OF $CH_3N_2CH_3$ AND $CH_3N_2CH_3-CD_3N_2CD_3$ MIXTURES. R. E. Rebbert and P. Ausloos (National Bureau of Standards, Washington, D. C.). J. Phys. Chem., 66: 2253-8(Nov. 1962).

Azomethane was photolyzed in the solid, liquid, and gaseous phases. In the gas phase photolysis, evidence was obtained for the formation of ethane by a molecular elimination from azomethane. The quantum yield of the formation of nitrogen in the liquid phase was lower than unity and decreased with decrease in temperature. Benzene quenched and 2,3-dimethylbutane enhanced the decomposition yield. The effect of collisional deactivation, molecular elimination, and free radical recombination in the cage on the total yield of ethane is discussed. Radiolysis experiments on mixtures of $CH_3N_2CH_3-CD_3N_2CD_3$ were performed in the liquid and solid phases. The results indicate that ethane is formed mainly by cage and intercage recombination in the γ-ray spur. A decrease in temperature and addition of solvents had a reducing effect on the relative yield of CH_3CD_3. Evidence for energy transfer from benzene to azomethane was obtained. (auth)

3045 THE EFFECT OF SUBSTITUTION ON THE IONIZATION POTENTIALS OF FREE RADICALS AND MOLECULES. IV. δ_k VALUES FOR ALCOHOLS, ETHERS, THIOLS, AND SULFIDES. Joyce J. Kaufman (RIAS, Baltimore). J. Phys. Chem., 66: 2269-71(Nov. 1962).

From measured photoionization potentials of amines a new set of constants, δ_k values, which quantitatively reflect changes in ionization potential with substituent groups, were derived and using them, ionization potentials of some alkyl free radicals were estimated to within the experimental error of their measurements. There is a saturation effect and the values are not linearly additive but can be combined following certain set precepts. The effects of substitution on ionization potentials are not the same for the series of alcohols and ethers as for the amines. δ_k values for oxygen containing compounds were determined. Since δ_k values derived from nitrogen compounds do not carry over into the oxygen series, a specific set of δ_k values for use with oxygen compounds is presented. The values are based on photoionization measurements of the molecules. (P.C.H.)

3046 γ-INITIATED CROSSLINKING OF UNSATURATED POLYESTERS. W. Burlant and J. Hinsch (Ford Motor Co., Dearborn, Mich.). J. Polymer Sci., 61: 303-9(Oct. 1962).

Unsaturated polyesters containing 1.5, 3.2, and 4.8 double bonds per molecule (derived from maleic anhydride, phthalic anhydride, and propylene glycol) were crosslinked by γ rays from Co^{60}. From sol fraction data and from measurements of the molecular weight between crosslinks of the corresponding gel, it is concluded that for polymers containing more than about 4 double bonds per molecule, γ-initiated bond formation is in accord with the reported chain reaction scheme for such systems. At lower degrees of unsaturation, a significant fraction of the initially available unsaturated sites was consumed at the gel point so that subsequent radiation (and radical formation), which effects chain growth at the expense of intramolecular crosslinking, appears to be in part, a random process. It is suggested that radiation-induced changes in unsaturated polyesters are best described in terms of the simultaneously occurring chain growth and intramolecular crosslink formation. (auth)

3047 ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED ACRYLAMIDE AND METHACRYLAMIDE. Hisashi Ueda and Zenichiro Kuri (Tokyo Labs.). J. Polymer Sci., 61: 333-41(Oct. 1962).

Electron spin resonance (ESR) spectra of the irradiated monomers and polymers of both acrylamide and methacrylamide were studied. On thermal treatment, the spectra are changed both in their patterns and in intensity. The polymerization yield of these monomers after irradiation followed by the same thermal treatment as with that used for ESR samples was also studied. The radicals existing in the irradiated acrylamide are concluded to be a mixture of two kinds of radicals, one at the ends and the other in the middle of the polymer chain. (auth)

3048 IRRADIATION OF CRYSTALLINE POLYETHYLENE. Ronald Salovey (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Polymer Sci., 61: 463-73(Oct. 1962).

Measurements of crosslinking, unsaturation, and hydrogen evolution following electron bombardment are similar for bulk polyethylene and fast-filtered single crystals. Slow-filtered single crystals evidence a unique irradiation behavior. It is suggested that irradiation-induced crosslinking is preferentially between the layers of polyethylene single crystals if the lamellae are in close contact. Following slow filtration, the lamellae are separated, while fast filtration of single crystal preparations brings the lamellae into contact. Moreover, it is possible that the bulk polymer is composed of folded molecules in compacted lamellae. (auth)

3049 SCINTILLATION MEASUREMENT OF AQUEOUS SOLUTIONS OF BETA EMITTERS. Josef Klumpar and Miroslava Majerová. Jaderña Energie, 8: 356-62(1962). (In Czech)

After studying various methods of direct measurement of aqueous solutions of radioisotopes using various liquid and solid scintillators and from some measurement of detection yield — in the dependence on solution composition and radiation energy — it was concluded, that the measurement of evaporation residue is the most convenient method of radioisotope measurement in low concentrations. The optimum condition of a new type of thin scintillator was found. Its advantages, such as minimum sensitivity to gamma background (needs practically no shielding) and independence of its detection yield on beta radiation energy (in the case of negligible radiation self-absorption in the evaporation residue), were proved. (auth)

3050 FORMATION OF RADICALS IN RADIOLYSIS OF SOLID ORGANIC SUBSTANCES. 1. CORRELATIONS OF RADICAL YIELDS IN VARIOUS ORGANIC COMPOUNDS. Yu. N. Molin, I. I. Chkheidze, E. P. Kaplan, N. Y. Buben, and V. V. Voevodskii. Kinetika i Kataliz, 3: 674-9(Sept.-Oct. 1962). (In Russian)

An electron paramagnetic resonance method was used for measuring the radiative yields of radicals in perhydroaromatic and aromatic hydrocarbons (benzene, diphenyl, terphenyl) and their derivatives. The yields were measured in the initial radical accumulation regions at −170 to 110°C. It was found that the yield from perhydroaromatic and hydroaromatic hydrocarbons without multiple conjugated bonds is several radicals per 100 ev of absorbed energy. In aromatic compounds the yield is 1 to 2 factors smaller. Moreover, the yield is reduced with increased conjugation. A scheme for molecular radiation stability at the first excitation level is included. (tr-auth)

3051 ENERGY MIGRATION AND TRANSFER IN SOLID ARGON AND KRYPTON AT LOW TEMPERATURES. Walter V. Bouldin, Raymond A. Patten, and Walter Gordy (Duke Univ., Durham, N. C.). Phys. Rev. Letters, 9: 98-100(Aug. 1, 1962).

The electron spin resonance spectra of CD_3 and D radi-

cals produced in solid Ar and Kr by gamma irradiation at 4.2°K are studied. CD_4 mole fractions of 10^{-5} to 10^{-1} are introduced into the rare-gas matrix, and are irradiated with doses up to 1.6×10^6 r. It is concluded that a large fraction of the CD_3 and D radicals are produced by energy transfer from the rare gas to the CD_4, rather than by direct energy absorption by the CD_4 molecule from the photons. (T.F.H.)

3052 RADIOPROTECTIVE AND RADIOMIMETIC EFFECTS OF PROPYLGALLATE IN GLYCINE AND HEMIN. M. I. Amirogova and N. A. Duzhenikova. Radiobiologiya, 2: 607-10(1962). (In Russian)

Protective effects of propyl gallate in glycine were studied The protective effects depend on the pH of the medium and reach a maximum in alkali environment. In alkali medium (0.1 n NaOH) propyl gallate induces changes in hemin similar to those induced by radiation and by oxidation by inorganic peroxides. (R.V.J.)

3053 ELECTRON SPIN RESONANCE SPECTRA OF ALKYL RADICALS IN γ-IRRADIATED ALKYL HALIDES. P. B. Ayscough and C. Thomson (Univ. of Leeds, Eng.). Trans. Faraday Soc., 58: 1477-94(Aug. 1962).

A study of the electron spin resonance spectra of radicals trapped in γ-irradiated polycrystalline alkyl halides at −196°C established that in almost all cases the main species observed in the 1st hours after irradiation is the parent alkyl radical, though isomerization reactions such as isobutyl → tert-butyl occur at this temperature. Hyperfine splitting constants for the interaction of the α- and β-protons with the unpaired electron were determined for radicals with the formulas $(CH_3)_n\dot{C}H_{3-n}$ (n = 0 to 3) $RCH_2\dot{C}H_2$, $RR'CH\dot{C}H_2$, $RR'\dot{C}H$ (including cycloalkyl) and $RR'R''\dot{C}$. It was found that α-protons and those in freely rotating methyl groups interact to give isotopic hyperfine splitting of 60-75 Mc/sec, while the magnitude of the interaction of the β-protons may vary from <12 to >130 Mc/sec, depending on the configuration of the radical. In particular, the 2 β-protons in $RCH_2\dot{C}H_2$ are not equivalent, implying an unsymmetrical equilibrium configuration. Interpretation of the spectra of organic radicals trapped in polycrystalline matrices involves the consideration not only of the number of interacting protons and their relative orientation, but also of the effect of more distant groups which may affect the electron distribution and also the configuration of those groups which give observable hyperfine interaction. Simple alkyl radicals, with the single exception of the isobutyl radical, give spectra consisting of an even number of lines. Since differences in line separation are small, the interpretation must rely heavily on relative intensities which are readily altered by the superposition of similar spectra, or by incipient saturation. (H.H.D.)

3054 RADIOAKTIVNYI IZOTOP TSEZIYA Cs^{137}. (Radioactive Cesium — Cs^{137}). V. A. Zaitsev and A. I. Grivkova. Moscow, Gosatomizdat, 1961. 29p.

Applications, nuclear properties, and separation of Cs^{137} were analyzed and safety measures in handling Cs^{137} are discussed. 44 references are included. (R.V.J.)

3055 IRRADIATION OF VINYL CHLORIDE POLYMER PLUS TWO UNSATURATED MONOMERS. Wendell V. Smith (to U. S. Rubber Co.). U. S. Patent 3,061,531. Oct. 30, 1962.

The introduction of a monomeric ester of an alpha-unsaturated dicarboxylic acid and monomeric vinylidene compound into a vinyl chloride polymer produces materials that are resistant to the effects of radiation. (R.J.S.)

Raw Materials and Feed Materials

Refer also to abstracts 3868 and 3870.

3056 (HW-63501) OPERATION AND CIRCUIT DESCRIPTION OF THE CALCINER CONTROL PROGRAMMER. N. P. Wilburn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1960. Contract AT(45-1)-1350. 93p.

The Calciner Control Programmer is described and its operation under normal and emergency conditions is discussed. The electric circuitry is described in order to make maintenance as easy as possible. (M.C.G.)

3057 DESCRIPTION AND OPERATION OF AN INSTALLATION FOR THE PRODUCTION OF U_3O_8 FROM URANIUM HEXAFLUORIDE ENRICHED 20% IN U^{235}. J. L. del Val Cid, J. M. Regife Vega, and J. M. Clement Casado (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 71-8(Jan.-Mar. 1962). (In Spanish)

The general characteristics of installations working with enriched U are indicated with respect to the requirements for safety and health physics. The process and installation for the production of enriched of U_3O_8 for the fabrication of fuel elements are described. The process uses enriched UF_6 in a batch procedure. The U_3O_8 obtained fulfills the specifications established for this type of material, and the total transformation yield is more than 99.7%. (tr-auth)

3058 RECOVERY OF ENRICHED URANIUM (20% U^{235}) FROM RESIDUE OBTAINED IN THE PREPARATION OF FUEL ELEMENTS FOR ARGONAUT TYPE REACTORS. A. Uriarte, L. Ramos, J. Estrada, and J. L. del Val (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 79-86(Jan.-Mar. 1962). (In Spanish)

The construction and the results obtained in the installations for the recovery of enriched uranium from scrape are indicated. The two types of installations discussed are an ion exchange type and a solvent extraction type. The ion exchange installation recovers the uranium from aqueous solutions obtained from the precipitation of ammonium diuranate from UO_2F_2 solutions. In the other type of installation, the solid scrap from the fuel element fabrication is dissolved and the uranium is extracted with 10% TBP. (J.S.R.)

3059 THE INVESTIGATION OF THE PREPARATION OF ACTIVE URANIUM DIOXIDE FROM METAL URANIUM IN A DRY WAY. Karel Seidl. Jaderňa Energie, 8: 363-6 (1962). (In Czech)

Uranium metal was oxidized to U_3O_8 by air in the temperature range from 300 to 700°C. The properties of UO_2 prepared by reduction were improved by double oxidation-reduction cycling at 550 and 650°C, respectively. Optimum characteristics of cycling were based on the results of the oxidation of uranium dioxide by air in the temperature range from 400 to 700°C, and of the U_3O_8 reduction by hydrogen in the temperature range from 500 to 700°C. Chemical reactivity of powdered UO_2 was measured in standard conditions using the reaction with gaseous hydrogen fluoride and hydrogen. (auth)

3060 METHOD FOR OBTAINING PLUTONIUM METAL AND ALLOYS OF PLUTONIUM FROM PLUTONIUM TRICHLORIDE. James G. Reavis, Joseph A. Leary, and William J. Maraman (to U. S. Atomic Energy Commission). U. S. Patent 2,063,829. Nov. 13, 1962.

A process is given for both reducing plutonium trichloride to plutonium metal using cerium as the reductant and simultaneously alloying such plutonium metal with an ex-

cess of cerium or cerium and cobalt sufficient to yield the desired nuclear reactor fuel composition. The process is conducted at a temperature from about 550 to 775°C, at atmospheric pressure, without the use of booster reactants, and a substantial decontamination is effected in the product alloy of any rare earths which may be associated with the source of the plutonium. (AEC)

3061 CONTINUOUS PRECIPITATION METHOD FOR CONVERSION OF URANYL NITRATE TO URANIUM HEXAFLUORIDE. G. M. Reinhart and T. J. Collopy (to U. S. Atomic Energy Commission). U. S. Patent 3,063,792. Nov. 13, 1962.

A continuous precipitation process is given for converting a uranyl nitrate solution to uranium tetrafluoride. A stream of the uranyl nitrate solution and a stream of an aqueous ammonium hydroxide solution are continuously introduced into an agitated reaction zone maintained at a pH of 5.0 to 6.5. Flow rates are adjusted to provide a mean residence time of the resulting slurry in the reaction zone of at least 30 minutes. After a startup period of two hours the precipitate is recovered from the effluent stream by filtration and is converted to uranium tetrafluoride by reduction to uranium dioxide with hydrogen and reaction of the uranium dioxide with anhydrous hydrogen fluoride. (AEC)

Separation Processes

Refer also to abstracts 2773, 3724, 3869, 3871, 3873, 3874, and 3875.

3062 (AAEC/TM-156) AN APPARATUS FOR DISSOLVING IRRADIATED FUEL SPECIMENS AND ACCURATELY SAMPLING THE SOLUTION. J. R. Coady, M. S. Farrell, and R. J. Starling (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Sept. 1962. 15p.

Details are given of an apparatus used to dissolve irradiated ceramic, metallic, and carbide fuel specimens, to dilute the dissolver solutions accurately to a known volume, and to take aliquots with a specially adapted automatic burette. Procedures for its use are given. (auth)

3063 (ACNP-62021) STEAM SEPARATION TECHNOLOGY QUARTERLY PROGRESS REPORT, JUNE–SEPTEMBER 1962. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Oct. 10, 1962. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1186. 70p. (EURAEC-453)

The air-water facility which will be used to develop downcomer, upcomer, and cross-over type separators and to investigate carryunder in a natural circulation system without mechanical separators was put into operation earlier than anticipated. A series of tests were performed to provide information to be used in the detail design of experiments to be performed in the air-water tank. The centrifugal separator development program is now in progress in the loop. A program was undertaken to correlate air-water and steam-water experiments. To obtain air-water void fraction data to compare with steam-water void fraction data from a previous program, a small auxiliary test apparatus was constructed and operated. These data were correlated and an equation was developed to permit the prediction of the void fraction in a bubbling two-phase mixture as a function of certain basic parameters. The comparison of experimental values with calculated values indicates the correlation is reasonably accurate. (auth)

3064 (DP-370) HYDRAULIC PERFORMANCE OF A 5-INCH CENTRIFUGAL CONTACTOR. Donald S. Webster (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.); Clifton L. Williamson, and James F. Ward (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Aug. 1962. Contract AT(07-2)-1. 14p.

A 5-inch centrifugal contactor for solvent extraction processes was operated to determine the capacity and efficiency as a function of bowl speed, weir positions, air entrainment, and flow ratios for solvent extraction systems for processing nuclear fuels. (auth)

3065 (HW-52755) DEVELOPMENT OF AN IMPROVED AGITATOR FOR THE REDOX SEPARATIONS PLANT. J. Dunn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 19, 1957. Contract W-31-109-Eng-52. 8p.

A low-speed agitator for use in the Redox Process was constructed and operated for over 10,000 hr under maximum vibration conditions without developing weaknesses. The gear-reduction drive, submerged and separate external shaft bearings, and rotary mechanical shaft seals were eliminated by development of a vertical, hollow-shaft, 225 rpm electric motor. The motor accommodates a 4-in. diameter hollow agitator shaft. The motor bearings provide support and guidance for the shaft and paddle turbine assembly. Agitation and uniform blending of the contents of a 10-ft-diameter by 10-ft-deep tank is possible with less than one minute of operation. (auth)

3066 (HW-75051) PUREX PLANT TEST OF THE CESIUM NICKEL FERROCYANIDE PROCESS. S. J. Beard and W. C. Schmidt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Sept. 25, 1962]. Contract AT(45-1)-1350. 8p.

A cesium recovery of 99 per cent with a sodium decontamination factor of 900 was demonstrated during a full scale plant test of the cesium nickel ferrocyanide process conducted in the Purex Plant head-end precipitation equipment using aged high level waste supernatant solution as feed. The sodium content of the resulting product was low enough to permit satisfactory cesium loading on most synthetic zeolites being considered in fission product and waste packaging studies. About 30 kilocuries of purified cesium product were shipped to Hanford Laboratories Operation for future packaging studies. (auth)

3067 (HW-SA-2246) EXTRACTION OF TETRA- AND HEXAVALENT ACTINIDES FROM HYDROCHLORIC ACID BY TRI-N-OCTYLAMINE IN XYLENE. W. K. Keder (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [July 26, 1961]. Contract AT(45-1)-1350. 21p.

Distribution data for extraction of the tetra- and hexavalent actinides from hydrochloric acid by tri-n-octylamine (TOA) solutions are reported and the spectra of the extracted complex ion species are shown. The hexachloro complexes of the tetravalent metals are found to extract. The data also indicate the extraction of the tetrachloro actinyl ions, but the identity of these ions is not fully established. (auth)

3068 (HW-SA-2290) CONTINUOUS ANION EXCHANGE PROCESSING OF PLUTONIUM. G. C. Oberg and W. H. Swift (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 3, 1961. Contract [AT(45-1)-1350]. 29p.

The Hanford continuous anion exchange process for purification and concentration of plutonium nitrate solutions is discussed. Information is given on the unique proc-

ess chemistry and aspects peculiar to plutonium processing. The continuous contactor design and operating experience is reported. (auth)

3069 (LADC-4369(Rev.2)) SEPARATION OF THE LANTHANONS AT AMALGAM CATHODES. V. A KINETIC STUDY OF LUTETIUM ENRICHMENT IN METHANOL ELECTROLYTES. E. I. Onstott (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 28p.

A kinetic study of the electrolytic phase transfer of radioactively tagged Tm in the presence of many-fold excess Lu at an amalgam cathode was done in boiling, refluxing methanol to demonstrate Lu enrichment in the electrolyte and to show electrode reactions. Under near optimum conditions Lu of 99% purity was enriched to 99.9% purity in one electrolysis in 20% yield. In a different experiment in which a mixture of Ho, Er, Tm, and Lu was electrolyzed, Ho was enriched 5-fold in the amalgam phase. The kinetic studies showed that there is a simultaneous electrosolvolytic reaction which generates base (probably hydroxide ion from residual water in the methanol) and precipitates the lanthanons from the electrolyte in a specific region of the system. The parameters of current density, total electrolyte concentration of lanthanons, and water content of the methanol markedly affect certain electrode reactions. (auth)

3070 (ORNL-TM-265) CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT SECTION C PROGRESS REPORT FOR APRIL–JUNE 1962. K. B. Brown (Oak Ridge National Lab., Tenn.). Aug. 10, 1962. Contract [W-7405-eng-26]. 77p.

Substituted phenols continued to show promise as extractants for recovery of cesium from adjusted simulated Purex wastes. A benzyl-substituted compound, 4-sec-butyl-2-(α-methylbenzyl)phenol (BAMBP) showed much greater cesium extraction power than any other phenol tested. Study of cesium extraction coefficient dependence on phenol concentration indicated that it is at least third power, and loading tests with concentrated cesium solutions gave a maximum cesium loading of one mole per six moles of phenol. In batch countercurrent tests, cesium recoveries ranging from 97.4 to 99.9% were obtained from simulated Hanford tank farm supernate waste with o-phenylphenol (OPP) and from simulated adjusted Purex 1WW waste with OPP, BAMBP, and 4-chloro-2-phenylphenol. The cesium was quantitatively stripped from the extracts with 0.05 volume of 0.05 M HNO_3. Overall Cs/Na decontamination factors for these tests ranged from 5,000 to 20,000. In the di(2-ethylhexyl)phosphoric acid (D2EHPA) process for recovering strontium and rare earths from Purex waste, inclusion of an acid scrubbing step in the third cycle greatly improved the separation from sodium and allowed more efficient concentration of the strontium in the stripping cycle. Extraction of rare earths with D2EHPA from tartrate-complexed simulated Purex 1WW was slow and the order of extractability was Pm > Ce > Eu > Y. In contrast, extractions from $NaNO_3$–HNO_3 solution were rapid and the order of extractability was Y ≫ Eu > Ce, Pm. The rate of stripping with HNO_3 was also rapid. Comparison of the strontium extraction ability of several organophosphorus acids showed large variations in extraction power with only one compound, phenyl(1-hydroxy-2-ethylhexyl)phosphinic acid, giving higher strontium coefficients than D2EHPA. Study of amine pretreatment of simulated Purex 1WW to produce a feed highly amenable to solvent extraction recovery of strontium and cesium was continued. In tests with Primene JM, >95% of the nitrate and iron, >40% of the sulfate, >98% of Zr-Nb, ~90% of the Ru, and 60% of the cerium were extracted in a single contact, whereas extractions of cesium and strontium were <3%. Favorable results were also obtained with di(tridecyl)amine although extraction of iron was less efficient and phase separation was slower than with Primene JM. A useful balance between acid extraction power by amines and amenability to water stripping of the extracted acid was obtained by proper choice of amine basicity as determined by the type of branching. N-Benzyldi(2-ethylhexyl)amine in particular was found capable of extracting >90% of the sulfuric acid from Sulfex decladding process waste and releasing it to the strip solution at ~1 M H_2SO_4. Distribution of trilaurylamine from 0.3 M solution in diethylbenzene to 3 and 4 M acetic acid solutions (as used for stripping extracted plutonium) was <20 ppm in the aqueous phase, and probably close to zero. Distribution of the diethylbenzene to the aqueous phase was greater than that of the amine, but still <80 and <150 ppm in 3 and 4 M HOAc. Of eight hydroxy-substituted polyamines tested, only three extracted uranium from acidic sulfate solution and coefficients for these compounds (0.1 M in xylene) were low (1 to 7). Isotherms for extraction of uranium from a sulfate leach liquor with Aliquat 336 (quaternary) showed this compound to be a much weaker uranium extractant than the tertiary and secondary amines. Comparative data were obtained for extraction of vanadium(IV), vanadium(V), scandium, and chromium(III) from HCl and LiCl–0.2 M HCl solutions (0.5 to 10 M ΣCl) with representative primary, secondary, tertiary, and quaternary amines. In general, extraction coefficients increased with increase in chloride concentration and were much higher for Aliquat 336 than for the other amines. Maximum extraction coefficients obtained with Aliquat 336 (0.1 M) were ~100 for vanadium(V) and vanadium(IV), 0.35 for scandium, and 0.6 for chromium(III). Nearly one hundred liquid-solid combinations, were tested for their ability to remove diluent degradation products from a degraded TBP-Amsco 125-82 solution. Most effective cleanup was achieved by ethanolamine. Since ethanolamine costs slightly more than the same volume of 1 M TBP, the economy of its use depends strongly upon the severity of reagent degradation and the phase ratios required for effective cleanup. Recovery of the amine was not studied. Additional low molecular weight amines and alkanolamines were tested and showed possible utility. Mixtures of ethylene glycol with inorganic and organic bases were not as effective as ethanolamine. Triethylphosphate and sulfuric acid each achieved some cleanup, but with high loss of TBP to the scrub solution. Attempts to destroy the extracting degradation products by chemical reaction (with iodine and reducing agents) were only partially successful. Significant suppression of Zr-Nb and Ru extraction was demonstrated on treating feeds with certain oximinoketones, a class of compounds previously proposed as contributing to similar suppression by treatment with acetone plus nitrite. Further study of oximinoketones showed that a part, in some cases a major part, of their effect was due to oxalic acid, present as either a synthesis by-product or a decomposition product of the oximinoketone. Direct batch tests showed oxalic acid more effective than oximinoketones in suppressing Zr-Nb and Ru extraction, but indicated a possibility of impaired extractions or precipitation of Pu, U, and Th. In spite of such indications, use of oxalic acid feed treatment in processing of actual irradiated fuel dissolver solution improved the decontamination of uranium from gross β and γ activity by a factor of 20 to 30, without impairment of overall U or Pu recovery. Correction of extraction data for presence of oxalic acid showed that the oximinoketones and/or possibly other degradation prod-

ucts (e.g., diketones) still gave improved uranium decontamination from Zr-Nb and Ru in batch tests and in countercurrent extractions from solutions of irradiated fuel elements. The extraction of sodium from 4 M $NaNO_3$ by D2EHPA in benzene was investigated by tracer methods. E_{Na} was found $\propto [H^+]^{-1}$ as expected for a simple neutralization. Some sodium in excess of stoichiometric was found in the organic phase. The quantity of excess sodium increased in a regular manner as the percent of D2EHPA in the sodium salt form (stoichiometric) increased. Since the amount of water in the organic phase increased in a like manner it is proposed that the excess sodium is simply present as dissolved sodium nitrate. (auth)

3071 (TID-14891) SYNERGISM IN THE SOLVENT EXTRACTION OF DI, TRI AND TETRAVALENT METAL IONS. PART III. ANTISYNERGISM WITH THENOYL TRIFLUORACETONE. T. V. Healy and G. W. Mason (Argonne National Lab., Ill.). Nov. 27, 1961. Contract [W-31-109-eng-38]. 32p. (UAC-5880)

Greatly enhanced extraction (synergism) of di, tri, and tetravalent cations from aqueous solution were previously reported for the system H_2O/M^{n+}/HTTA/S/diluent, where S is a neutral organophosphorus ester and HTTA is thenoyl trifluoracetone. Examples are given where S contains no phosphorus and is an amide alcohol or ketone. Complete destruction of this greatly enhanced extraction by addition of excess S whether the neutral additive is a phosphorus ester, an amide, alcohol, or ketone was demonstrated. These antisynergic effects are shown to be greater than, but the same type as, the effects due to some so called inert diluents. This phenomenon of antisynergism is shown to be connected with the water content of the organic phase and the destruction of the anhydrous synergic species $M(TTA)_xS_y$. Water enters the complex which reverts to a $M(TTA)_x$ hydrate. Absorptiometric measurements demonstrated three different spectra for HTTA/TBP in nonaqueous solution: the enolate form in dry TBP, probably hydrogen bonded to the TBP; the normal enol form in hexane solution in the presence or absence of low concentrations of TBP and water; and the ketohydrate form in water equilibrated TBP. $UO_2(TTA)_2$ or $Th(TTA)_4$ in dry TBP have the HTTA enolate spectra whereas in wet TBP the metal/TTA enol spectra obtains, evidence that water hydrates the anhydrous synergic species, causing antisynergism to occur. (auth)

3072 (TID-17264) DEVELOPMENT OF SEPARATION PROCEDURES FOR RADIOACTIVE MATERIALS. Quarterly Technical Status Report No. 11, July 1, 1962 to September 30, 1962. Robert J. Klett (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Oct. 10, 1962. Contract AT(38-1)-202. 8p.

An evaluation was made of the acid extraction characteristics of Alamine-336 in diethylbenzene diluent for the separation by solvent extraction of fission products. A series of runs was concluded utilizing a pure mixed nitric–sulfuric acid aqueous stream and, at present, work is underway on a simulated fission product aqueous acid stream. (auth)

3073 (TID-17265) DEVELOPMENT OF SEPARATION PROCEDURES FOR RADIOACTIVE MATERIALS. Quarterly Technical Status Report No. 10, April 1, 1962 to June 30, 1962. Robert J. Klett (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). July 10, 1962. Contract AT(38-1)-202. -46p.

Data were correlated on the system di-2-ethylhexyl phosphoric acid (D2EHPA) in Amsco 125-82 diluent for the separation by solvent extraction of the Group II elements strontium, barium, and calcium. The data on which the correlation is based are reviewed and summarized along with the preliminary calculations which were made. The preliminary attempts at correlating the data are presented and discussion as to their weaknesses is included. The present scheme of data reduction, based on divalent extractable species only, is covered and calculated equilibrium constants for the Group II metal ions in the presence of sodium are included for 0.1, 0.8, and 1.6M D2EHPA organic phases. The calculated data are also presented as a series of figures. (auth)

3074 (UCRL-9699) CARRIER-FREE SEPARATION OF HAFNIUM FROM RARE-EARTH OXIDES. Mab I. Tocher and Jack M. Hollander (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1961. Contract W-7405-eng-48. 5p.

A carrier-free separation of hafnium from several hundred milligrams of rare earth oxides by anion exchange from saturated HCl solution is given. The procedure is completed in 4 to 8 hours and is suitable for remote control work. (auth)

3075 (AWRE/Trans/33) QUANTITATIVE SEPARATION OF BERYLLIUM FROM VARIOUS ELEMENTS BY THE METHOD OF ION-EXCHANGE CHROMATOGRAPHY. T. A. Belyavskaya and V. I. Fadeeva. Translated by F. E. Wallwork (U.K.A.E.A. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Vestn. Mosk. Univ. Ser. Fiz. Mat. Estestv. Nauk., 11: No. 6, 73-9(1956). 11p.

The possibilities for quantitative separation of Be from Cu, Ni, Mo, and P by ion-exchange chromatography are discussed briefly. (R.J.S.)

3076 NEW EQUIPMENT FOR LIQUID-LIQUID EXTRACTION. Olle Lindstroem and Sune Flink. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 221-38(1962). (In English)

A new concatenated column system for liquid-liquid extraction was developed. The column elements are joined by single transfer lines with a contained volume equal to, or smaller than, the pulsed volume. A number of additional features were developed to improve the usefulness of the system. Experiences with the operation of a fully integrated pilot "bench-top uranium refinery," incorporating these features, are described. The advantages of the ASEA column are most obvious in the case of fuel reprocessing where important reductions in plant investment are expected because of the compact structure of this type of contactor. The system is also quite useful for general applications on a laboratory, pilot-plant, and full-size scale in view of its simplicity, ruggedness, flexibility and the absence of complicated and expensive auxiliary equipment. (auth)

3077 THE EXTRACTION OF ANIONIC BERYLLIUM COMPLEXES BY TRI-ISO-OCTYLAMINE. H. J. de Bruin, D. Kairaitis, and R. B. Temple (Australian Atomic Energy Commission, Lucas Heights). Australian J. Chem., 15: 457-66(Aug. 1962).

The extraction of beryllium from aqueous solution by long-chain tertiary amines was observed in the presence of ligands giving rise to anionic complexes. The nature of the oxalate complex extracted by solutions of tri-iso-octylamine in chloroform was studied in detail and the species formed in the organic phase were shown to have the composition $Be(C_2O_4)_2 \cdot \{NH(i\text{-}C_8H_{17})_3\}_2$. The complexes formed in aqueous solution between beryllium and several anionic complexing agents were examined by the method of pH titration. Conditional stability constants were obtained

for the complexes formed with oxalic, malonic, maleic, succinic, phthalic, and salicyclic acids. Differences in their extractabilities can be explained semiquantitatively with the help of the stability constants and the acid association constants of the complexing agents. (auth)

3078 STUDIES OF URANYL HYDROLYSIS FROM NITRATE SOLUTIONS. N. M. Nikolaeva, V. I. Paramonova, and V. B. Kolychev (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 3, 70-9(1962). (In Russian)

Ton exchange, dilution, and spectrophotometric methods were used in the investigation of the initial stages of UO_2^{2+} hydrolysis in nitrate solutions. Two nuclear compounds $U_2O_5^{2+}$ form during uranyl hydrolysis in dilute solutions (C ≈ 0.001 to 0.05 M). The values of $K_{2,2} = [(U_2O_5^{2+})(H^+)^2/(UO_2^{2+})^2]$ calculated by dilution and spectrophotometric methods are 0.8×10^{-6} (dilution method) and 0.5×10^{-6} (spectrophotometry). The constant value of $K_{5,3} = [(U_3O_8OH^+)(H^+)^5/(UO_2^{2+})^3]$ calculated by ion exchange is 10^{-16}. (R.V.J.)

3079 COUNTERCURRENT COMPUTATION ON TRINITRATO COMPLEX OF NITROSYLRUTHENIUM IN THE PRIMARY SEPARATION PLANT OF REACTOR FUEL PROCESSING. Masao Takigishi (Atomic Fuel Corp., (Tokyo). Nippon Genshiryoku Gakkaishi, 4: 685-92(Oct. 1962). (In English)

Differential equations based on the kinetics of the interchange between organic and aqueous phases have been developed to the countercurrent computation on stripping and extraction of the trinitrato complex of nitrosylruthenium. The application of solutions to the process could express sufficiently the performance of mixer settler systems, and it has been also suggested that the mixing time should be arranged to give a reasonable change of concentration in each section. It is also possible to analyze the Ru recycling in the extraction section and the feed stage as previously suggested by Fletcher. (auth)

3080 THE REMOVAL OF ^{113}Sn IN AQUEOUS SOLUTION WITH TIN METAL. Yuichiro Kamemoto and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 713-15(Oct. 1962). (In Japanese)

It is well known that an exchange reaction between a metal and its ion in solution occurs at the surface of the metal. The removal of Sn^{113} from an aqueous solution with Sn metal has been studied using the techniques of this exchange reaction. When 2ml of 0.4 N-HCl solution containing trace amounts of Sn^{113} was shaken vigorously with 100 mg of Sn powder for about 10 min, up to 80% of Sn^{113} was removed from the solution. The lower the normality of HCl solution containing Sn^{113}, the higher the rate of removal of Sn^{113} observed; for example, about 95% of the Sn^{113} was removed from the solution of about 10^{-4}N-HCl. It was found that up to ~80% of the Sn^{113} was rapidly removed from the 0.4N-HCl solution containing ~670 μg of Sb and 10^{-5} mol of citric acid per ml using this exchange reaction technique with Sn metal and that about 4% of the Sb was deposited on the Sn in this case. (auth)

3081 AUTOMATIC RECORDING INSTALLATION FOR CONTINUOUS RADIOISOTOPE EXTRACTION. K. B. Zaborenko and Atif Alian (Moscow State Univ.). Zavodsk. Lab., 28: 1380-2(1962). (In Russian)

A design is given for a mixer-precipitator type extractor capable of continuous extraction and re-extraction by lighter or heavier than water solvents. A typical extraction diagram for combined U and Th extraction from 4 M nitric acid solution by 30% tributyl phosphate in o-xylole is included. The initial uranyl content is 10 g; thorium nitrate, 0.2 g; with additions of UX, labeling for thorium and 238 ml of solvent. Separation of uranyl nitrate and Th^{234} in 4 nitric acid solutions was achieved by 5% tri-n-butyl phosphate in benzene followed by re-extraction by aqueous solution. (R.V.J.)

3082 SEPARATION OF URANIUM, PLUTONIUM AND FISSION PRODUCTS FROM NEUTRON-BOMBARDED URANIUM. Allan E. Martin, Irving Johnson, Leslie Burris, Jr., Irvin O. Winsch, and Harold M. Feder (to U. S. Atomic Energy Commission). U. S. Patent 3,063,830. Nov. 13, 1962.

A process is given for removing plutonium and/or fission products from uranium fuel. The fuel is dissolved in molten zinc–magnesium (10 to 18% Mg) alloy, more magnesium is added to obtain eutectic composition whereby uranium precipitates, and the uranium are separated from the Plutonium- and fission-product-containing eutectic. (AEC)

3083 RECOVERY OF ALUMINUM FROM FISSION PRODUCTS. R. E. Blanco and I. R. Higgins (to U. S. Atomic Energy Commission). U. S. Patent 3,065,044. Nov. 20, 1962.

A method is given for recovering aluminum values from aqueous solutions containing said values together with fission products. A mixture of Fe_2O_3 and MnO_2 is added to a solution containing aluminum and fission products. The resulting aluminum-containing supernatant is then separated from the fission product-bearing metal oxide precipitate and is contacted with a cation exchange resin. The aluminum sorbed on the resin is then eluted and recovered. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 2747, 2750, 2754, 2755, 2756, 2759, 2760, 2761, 2762, 2766, 2767, 2774, 2775, 2778, 2780, 3560, 3654, 3708, 3709, 3710, 3711, 3712, 3716, and 3907.

3084 (ASD-TR-61-692) STRENGTH, EFFICIENCY, AND DESIGN DATA FOR BERYLLIUM STRUCTURES. Robert F. Crawford and A. Bruce Burns (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Feb. 1962. Contract AF33(616)-6905. 515p. (PB-181324)

The purpose of this study program was to investigate the design capabilities of beryllium as a structural material and to derive and develop structural design curves and related data for efficient structural design with beryllium. The metal beryllium is believed to have high potential for aerospace structures, but is not extensively considered in design applications at the present time because of uncertainties as to the proper design procedures. Information is presented which clearly shows that beryllium now may be designed with confidence into many types of load-carrying structures, using well-known methods of structural analysis and appropriate margins of safety. The resulting beryllium structures are shown to be considerably lighter than identical structures fabricated from other metals, and these structures are obtainable with currently available beryllium mill products. (R.J.S.)

3085 (IDO-14541) PHYSICAL AND OPERATIONAL FEATURES OF A PULSED CONTINUOUS COUNTERCURRENT LIQUID-SOLIDS CONTACTOR. E. S. Grimmett and B. P. Brown (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 20, 1961. Contract AT(10-1)-205. 17p.

The physical and operational features of a rapidly pulsed, continuous, countercurrent, liquid–solids contactor are described. The contactor consists of a 2-in.-dia. column containing five contact stages. Solids feeding, contactor operation, and pulsing methods are described. Ion exchange resin flow rates up to 150 lb/hr/ft^2 and calcined aluminum oxide flow rates up to 300 lb/hr/ft^2 were obtained while feeding water at rates up to 2000 lb/hr/ft^2. Optimum stage design should extend these rates considerably. The effects of pulse frequency and amplitude upon the column flow rate are described. Column ion exchange efficiencies were determined for the systems Cu–Na and Cu–H_2 at a cationic concentration of 0.1N. Sulfate was the common ion in the Cu–Na system and nitrate ion in the Cu–H_2 system. Stage efficiencies of greater than 27 to 62% were obtained. HTU values are also reported. (auth)

3086 (NIRL/R/19) THE DESIGN OF SOLENOIDS FOR THE PRODUCTION OF PULSED MAGNETIC FIELDS. J. D. Lewin (Gt. Brit. National Inst. for Research In Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England). June 1962. 38p.

The basic principles governing the design of wire-wound solenoids for the production of pulsed magnetic fields are summarized. The data given in a paper by K. S. W. Champion are presented in a new form which allows rapid selection of optimum coil parameters. A number of related problems are discussed, including low temperature operation, magneto-resistance, skin effect, coil heating, and choice of damping resistor. (auth)

3087 (TID-4100(1st Rev., Suppl.16)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Richard E. C. Duthie, ed. (Division of Technical Information Extension, AEC). Nov. 1962. 19p.

Included are lists under engineering equipment, fallout shelters, instruments, metallurgical equipment and processes, nuclear radiation instruments, nuclear reactors and facilities, particle accelerators, radiation source units, and thermonuclear devices. (R.J.S.)

3088 (UCRL-9828) SHEET METAL CAN FURNACE. Richard C. Doyle and Will D. Phillips (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 17, 1961. Contract W-7405-eng-48. 12p.

A small vertical cylinder-type furnace was developed. Semicircular ceramic heating elements were selected. Temperature control was provided by a variable transformer. The metal shell was protected from corrosion by a coating of epoxy and phenolic resins. (R.J.S.)

3089 THE UTILIZATION OF RADIOACTIVE ISOTOPES IN HYDROLOGY. V. MEASUREMENT OF THE WATER FLOW OF OPEN CURRENTS BY MEANS OF RADIOACTIVE TRACERS. H. Moser, F. Neumaier, and W. Rauert (Forschungsstelle für Radiohydrometrie, Munich). Atomkernenergie, 7: 321-4(Sept. 1962). (In German)

A method for measuring the flow rate of open currents by means of radioactive tracers is described and compared by experiments with classical methods. As for accuracy the tracer method is equivalent to the screw current meter even if this classical measurement is carried out under favorable conditions. The tracer method, however, can be applied to special flow patterns, where the current meter method does not give exact results. (auth)

3090 APPLICATIONS OF A SUBSURFACE SOLID-STATE ISOTOPE INJECTOR TO NUCLEAR-TRACER SURVEY METHODS. J. M. Edwards and E. L. Holter (McCullough Tool Co., Los Angeles, Calif. and Casper, Wyo.). J. Petrol. Technol., 14: 121-4(Feb. 1962).

The techniques of following the movement of dispensed isotopes in a wellbore with a gamma-ray detector have been described in previous literature. The method of determining fluid-movement profiles and velocity readings in wellbores has proved valuable for defining producing zones and thief zones, for water flooding for secondary recovery programs, and for solving lost-circulation problems. The Electric Isotope Injector utilizes a new principle to eliminate many of the disadvantages of previous downhole dispensers. This method injects radioisotope from a solid state directly into the surrounding fluid. The radioactivity is "fixed" on a metal "button" carried by the tool; when ready to perform an injection operation, the button is lowered to the appropriate depth in the well. The isotope is dispensed from the button by energizing the proper circuits in the logging system from the control panel in the logging service truck. The isotope remains in stable solution in the well fluid. The injector is run in combination with the Scintillometer gamma-ray logging tool for tracing the movement of the fluid. Using isotopes in solid-state form is a major improvement from the standpoint of radiation safety. The problems of radioactive-material spillage and contamination have been virtually eliminated. This new tool has been field-tested under high-temperature and high-pressure well conditions and has proved very reliable and dependable

under various well conditions. The substantial saving in operating time and the more reliable control permitted provides an economical and efficient subsurface tracer-survey system. (auth)

3091 SACLAY HOT CELLS ADVANCE PLUTONIUM-FUEL PROGRAM. André Valentin (Commissariat a l'Energie Atomique, Saclay, France). Nucleonics, 20: No. 7, 84-5(July 1962).

A description is given of Pu-handling equipment (cutting machinery, manipulators, microscope, and operation consoles) associated with the Saclay hot-cell facility. The procedures followed at this facility are also touched upon. (T.F.H.)

3092 AMERICIUM-241 SOURCES FOR ANALYTICAL APPLICATIONS. Nucleonics, 20: No. 11, 90(Nov. 1962).

Am^{241}, with a half life of 462 ± 10 yr and a specific activity of 7.0×10^9 dpm/mg, is valuable as a radiation source. The emitted radiations are 5.49-Mev alphas and 0.0597-Mev gammas. Am^{241} can be used as high-intensity alpha sources, low-energy gamma sources, and low-intensity neutron sources using (α,n) reactions of Be or B. (D.L.C.)

3093 Sr^{90} POWERS AN AUTOMATIC WEATHER STATION. Wilfred L. Kershaw (Martin Co., Baltimore). Nucleonics, 20: No. 11, 92; 94; 96-7(Nov. 1962).

The development of the first nuclear-powered weather system, now in operation on Axel Heiberg Island in the Arctic, is described. $SrTiO_3$ and Hastelloy C were selected as the Sr^{90} compound and container material, respectively, and a 5-watt thermoelectric generator and a data telemetry package were constructed. Test results and installation are described. (D.L.C.)

3094 IGNITRON-SWITCHED 0.6- TO 90-kv IMPULSE GENERATOR. Everet H. Beckner and Ralph H. Kotoski (Sandia Lab., Albuquerque, N. Mex.). Rev. Sci. Instr., 33: 914-15(Sept. 1962). (SCDC-2623)

An ignitron-switched impulse generator has been developed, capable of providing a variable output voltage of from 0.6 to 90 kv with no circuit alterations. The generator consists of 6 capacitor stages, yielding a total energy of 5000 J at 90 kv, and is discharged with a single trigger pulse. The discharge time can be controlled to within 0.1 μsec. (auth)

3095 GENERATION OF UNIFORM MAGNETIC FIELDS BY MEANS OF AIR-CORE COILS. Wolfgang Franzen (Boston Univ.). Rev. Sci. Instr., 33: 933-8(Sept. 1962).

The generation of uniform magnetic fields over extended regions of space by means of circular coils of large cross-sectional area is analyzed. It is shown by an extension of Garrett's theory of axially symmetric magnetic fields that the optimum shape of the coil cross section can be found analytically without numerical integration over the winding area. The theory is illustrated by application to Helmholtz coils and double Helmholtz coils of rectangular cross section. Choice of the optimum dimensions makes it possible to generate very uniform fields of great intensity. (auth)

3096 SELECTIVE PUMPING OF LIGHT AND HEAVY GASES WITH A MOLECULAR PUMP. E. Apgar, G. Lewin, and D. Mullaney (Princeton Univ., N. J.). Rev. Sci. Instr., 33: 985-6(Sept. 1962). (MATT-128)

For some plasma experiments high purity hydrogen or deuterium at pressures of 10^{-3} Torr or less is required. It is shown that a molecular pump can be used as a combination pumping, gas injection, and gas purification system. The gas is admitted to the fore vacuum side and streams back to the high vacuum side. This does not materially affect the pumping of heavy impurities. Performance data for this mode of operation are given for the Pfeiffer pump TVP-500. (auth)

3097 BAKEABLE HIGH CONDUCTANCE VACUUM VALVE. D. Mullaney (Princeton Univ., N. J.). Rev. Sci. Instr., 33: 1003-4(Sept. 1962).

Valves used in ultra-high vacuum systems must be constructed of low vapor pressure material, be bakeable to 450°C, have closed conductances of less than 10^{-10} l/sec, and have open conductances that do not seriously impede the pumping speed of the system. Unique characteristics of a valve used in plasma physics devices for the past few years are described. (W.D.M.)

3098 SPARK-GAP SWITCHING OF A 384-kJ LOW INDUCTANCE CAPACITOR BANK. L. M. Goldman, H. C. Pollock, J. A. Reynolds, and W. F. Westendorp (General Electric Research Lab., Schenectady, N. Y.). Rev. Sci. Instr., 33: 1041-4(Oct. 1962).

A three-electrode spark gap which can handle high energy (96 kj) was designed and used with a 384-kj capacitor bank having an operating range from 30 to 60 kv. The gap jitter time was reduced to less than 25 nsec. During θ-pinch experiments involving 3000 discharges of the bank, there was no significant deterioration of the gaps or variation of the electrical characteristics of the system. (auth)

3099 BIBLIOGRAPHY AND INDEX ON VACUUM AND LOW PRESSURE MEASUREMENT. W. G. Brombacher. National Bureau of Standards Monograph 35. (Department of Commerce, Washington, D. C. and National Bureau of Standards, Washington, D. C.). 105p. $0.60(GPO).

References (1538) are given to books and journals published from 1874 to 1960. Special attention is given to pressure measurement, including both vacuum gages and micromanometers. References are also given on vacuum technology, including adsorption, degassing, vacuum pumps, controlled gas leaks, valves, seals, and vacuum systems, all of which bear on the technique of vacuum measurement. Separate author and subject indexes are given. (P.C.H.)

3100 DEVICE FOR COOLING AND CONVEYING RABBITS IN A PNEUMATIC TUBE SYSTEM. Alfred Kuellmer, Friedrich Dieringer, and Walter Hartmann (to Licentia Patentverwaltungs GmbH). German Patent DAS 1,136,635. "Application date Nov. 22, 1958."

The device described is for the conveyance and cooling of rabbits in pneumatic tube systems where the rabbit is exposed to the radiation of a nuclear reactor or a particle accelerator. In the pneumatic tube system a single fluid medium is present for transferring the rabbit into and out of the radiation field as well as for cooling it. At the proper position inside the radiation field the rabbit is stopped or slowed down by a brake mechanism. The rabbit has helical ribs on its surface. The action of the pressurized fluid on the ribs gives the rabbit an angular momentum so that it rotates. A loose fit between the tube and the rabbit enables the fluid medium to be forced through the ring shaped space in order to cool the rabbit. (H.K.)

3101 TRANSFORMER APPARATUS. F. Wolfgang and J. Nicol (to U. S. Atomic Energy Commission). U. S. Patent 3,063,005. Nov. 6, 1962.

Transformer apparatus is designed for measuring the amount of a paramagnetic substance dissolved or suspended in a diamagnetic liquid. The apparatus consists of a cluster of tubes, some of which are closed and have sealed within the diamagnetic substance without any of the paramagnetic material. The remaining tubes are open to flow of the mixture. Primary and secondary conductors are wrapped

around the tubes in such a way as to cancel noise components and also to produce a differential signal on the secondaries based upon variations of the content of the paramagnetic material. (AEC)

3102 HIGH-VACUUM CONDENSER TANK FOR ION ROCKET TESTS. James Howard Childs and William R. Mickelsen (to National Aeronautics and Space Administration). U. S. Patent 3,063,291. Nov. 13, 1962.

A compact low-cost facility for testing ion rockets has been developed. The facility consists primarily of a vacuum tank for use at pressures of 10^{-7} mm of mercury and below. Cooled condenser baffles are employed to freeze the ion rocket exhaust and thereby obviate the need for pumping. (R.J.S.)

3103 THERMOELECTRIC GENERATOR. Henry L. Imelmann. (to Thermo Power, Inc.). U. S. Patent 3,064,063. Nov. 13, 1962.

A simple and compact apparatus is described for converting heat directly into electric energy. Relative movement between the heat source and the junctions defining the thermoelectric generator occurs so as to efficiently utilize the heat source for heating the junctions. (R.J.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 2763, 3363, 3887, 3888, 3889, 3890, 3895, and 4358.

3104 (AD-275462) THE FIRST-ORDER MHD FLOW ABOUT A MAGNETIZED SPHERE. Vivian O'Brien (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab.). Feb. 1962. Contract NOrd 7386. 31p. (CM-1011)

When both the velocity vector field and the magnetic vector field are axi-symmetric with no azimuthal components the system of equations for steady magnetohydrodynamic problems reduces to two scalar equations. These are used to find the flow field and magnetic field about a uniformly magnetized sphere correct to the first-order in the parameters: Hartmann number, Reynolds number, and magnetic Reynolds number. The first complete first-order field gives Drag = Stokes drag $(1 + \frac{3}{8}\ \mathrm{Re} + \frac{1}{150}\ \mathrm{M}$ squared). A similar relation is predicted for all first-order MHD flows about symmetric magnetized bodies. The multiplier of Re depends upon body shape; that of M squared depends upon both body shape and magnetic field. (auth)

3105 (BNL-5615) UNILATERAL HEAT TRANSFER TO LIQUID METALS FLOWING IN CONCENTRIC ANNULI. O. E. Dwyer and P. S. Tu (Brookhaven National Lab., Upton, N. Y.). July 10, 1961. Contract [AT(30-2)-Gen-16]. 41p.

Using a Lyon type of analysis, theoretical Nusselt numbers have been calculated for liquid metals flowing in concentric annuli, under conditions of constant heat flux and fully-established turbulent flow. These have been expressed in the form of semi-empirical equations for the case of heat transfer from the inner wall only and for the case of heat transfer from the outer wall only. Predictions on the basis of these equations are compared with those by other relationships and with experimental results. The proposed equations are consistent with those for turbulent flow of liquid metals inside circular tubes and between parallel plates; the former being the limit for an annulus as r_2/r_1 approaches infinity, and the latter being the limit as r_2/r_1 approaches unity. (auth)

3106 (IS-492) THERMAL DIFFUSIVITY MEASUREMENTS ON A FINITE DISK. Paul Dean Maycock and G. C. Danielson (Ames Lab., Ames, Iowa). June 1962. Contract W-7405-eng-82. 37p.

A new technique has been developed for measuring the thermal diffusivity of finite disk-shaped samples. The radial heat flow equation was solved by the method of finite differences. An axial heater was turned on and the temperatures at three radial positions were measured as functions of time. This procedure determined the boundary conditions necessary for the solution of the heat flow equation. By assuming various values of the thermal diffusivity, we obtained the solution at the middle thermocouple. The value that gave the best agreement between the computed solution at the middle thermocouple and the experimental curve obtained at the midpoint was considered to be the best value for the diffusivity. A FORTRAN program which calculates the diffusivity from the experimental data was developed, and an IBM 704 computer was used to process the data. Data on Armco iron show that the method is capable of giving correct values for thermal diffusivity. (auth)

3107 (JPL-TR-32-269) HEAT AND MOMENTUM TRANSFER IN SMOOTH AND ROUGH TUBES AT VARIOUS PRANDTL NUMBERS. Duane F. Dipprey and Rolf H. Sabersky (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). June 6, 1962. NAS 7-100. 36p.

Results are presented from an experimental investigation of the relation between heat transfer and friction in smooth and rough tubes. Three rough tubes and one smooth tube were formed from electroplated nickel. The rough tubes contained a close-packed, granular type of surface with roughness-height-to-diameter ratios ranging from 0.0024 to 0.049. Measurements of the heat transfer coefficients (C_H) and the friction coefficients (C_F) were obtained with distilled water flowing through the electrically heated tubes. A Prandtl number range of 1.20 to 5.94 was investigated by adjusting the bulk temperature of the water. Results were obtained for Reynolds numbers from 6×10^4 to 5×10^5 and from 1.4×10^4 to 1.2×10^5 at the lowest and highest Prandtl number, respectively. A similarity rule for heat transfer was used to correlate, interpret, and extend the experimental results. The results were compared with previously existing results, both theoretical and experimental. Increases in C_H due to roughness of as high as 270% were obtained. These increases were, in general, accompanied by even larger increases in C_F. An exception to this general behavior occurs at high Prandtl number in the region of transition between the "smooth" and "fully rough" C_F characteristic. (auth)

3108 (K-1531) A GENERALIZED CRITERION FOR THE LAMINAR-TURBULENT TRANSITION IN THE FLOW OF FLUIDS. Richard W. Hanks (Oak Ridge Gaseous Diffusion Plant, Tenn.). Nov. 19, 1962. Contract W-7405-eng-26. 135p.

A brief review and discussion is given of earlier attempts to formulate a stability criterion that is more general than the simple Newtonian Reynolds number. A new parameter is formulated and its general properties are discussed. The new parameter is applied to several different situations and is shown to be applicable in general to rectilinear flow systems. The applications that are compared with experimental data include isothermal flow of Newtonian fluids in pipes, in concentric annuli, and between parallel plates; isothermal and nonisothermal flow of pseudoplastic non-Newtonian fluids in pipes; and isothermal flow of semi-fluids (substances possessing finite yield stresses) in pipes. In addition to these experimentally verified results, theoretical calculations are presented for the isothermal flow

of pseudoplastic non-Newtonian fluids between parallel plates, isothermal flow of semifluid substances (in terms of the Bingham model) in concentric annuli and between parallel plates, isothermal flow of semifluid substances (in terms of the nonlinear Powell-Eyring rheological model in pipes. (auth)

3109 (K-1549) CONSTRUCTION OF ORIENTED FLOW DEVICES. C. J. King and E. G. Farrier (Oak Ridge Gaseous Diffusion Plant, Tenn.). Dec. 7, 1962. Contract W-7405-eng-26. 20p.

Ideas and techniques for construction of oriented flow devices are presented. The devices are cylinders with pores in the wall oriented to direct gas into the cylinder with a tangential component of velocity for the purpose of generating a vortex. These devices are of interest in connection with gaseous fission reactors. (auth)

3110 (MND-MD-2542) PM DEVELOPMENT — TASK 5.0 HEAT TRANSFER TESTS. AN EXPERIMENTAL, TWO-PHASE FLOW PRESSURE DROP STUDY. J. J. Jicha, R. Lightner, J. Cermak, T. Marrero, S. Frank, and T. Christenbury (Martin-Marietta Corp. Aerospace Div., Baltimore). Sept. 1962. Contract AT(30-1)-2706. 222p.

An experimental program to obtain two-phase (water-steam) flow pressure drop data for thick-plate flow restrictions and tubular test sections is reported. A statistically designed program of 536 runs was conducted employing six 30-in.-long test sections. Two nozzle-type, three thick-plate orifice-type and one straight expansion-type flow restrictions were investigated. Nozzle-type test sections simulated the inside flow path of the PM-1 tubular fuel element; the thick-plate orifice-type simulated the outside flow path. The ranges of parameters investigated were: quality — 0 to 23%; flow rate — 500 to 1500 lb/hr; pressure — 800 to 1600 psia; and tube diameters — 0.416 and 0.500 in. A complete factorial experimental design was employed permitting an analysis of variance to be conducted to determine the significance of the flow rate, quality, and pressure on the response of the static pressure drop. Inherent in the statistical methods employed was the establishment of the 95% confidence limits on the data for each test section studied. These limits varied with outlet flow restriction geometry and ranged from ±0.00869 to ±0.306 psia. Precision of the data was well within the limits for experimental two-phase flow technology. Results of an error analysis indicate that the accuracy with which flow rate, pressure and geometry were determined gave rise to insignificant errors. The maximum possible error in quality, while somewhat greater, especially at low qualities, does not impair the utility of the data. The two-phase static pressure drop data for the flow restrictions investigated were correlated with an equation of the form:

$$\Delta P_s = Z\left(\frac{1-\alpha'}{v_f} + \frac{\alpha'}{v_g}\right)\frac{g}{g_0} + \frac{K' v_f}{2g_0}\left[G\left(\frac{1-x}{1-\alpha'}\right)\right]^2$$

This relationship is employed in conjunction with the following expression for the effective void fraction:

$$\alpha' = \frac{1}{1 + \frac{1}{x}(Ax^2 + Bx + C)}$$

Deviations between the experimental values and those predicted by the correlation were computed for each of the 5 tubes considered and ranged from 8.9 to 17.5%. The data of the sixth tube, the one with no contraction loss, could not be correlated by the equations. Considering the data of the 5 tubes together, it was observed that 84% of the deviations are within ±20%. As expected, this good agreement of the correlation with the experimental results is somewhat biased in favor of the data with higher pressure drops. Comparisons of the combined pressure drop across the tube length and exit restriction, as calculated by the BITE automatic computer program and measured in the experiment, were also made. As before, the data from the tube with no exit contraction loss was not used. The correlation for exit restriction pressure drop had been incorporated into the BITE program for these calculations. Comparisons showed 98% of the computed points to be within ±20% of experimental values. The use of the developed correlation in conjunction with the appropriate effective void fraction expression is recommended for predicting two-phase static pressure differences across thick-plate flow restrictions. This technique was incorporated into the Martin thermal-hydraulic design code, BITE. An alternate option in BITE allows direct interpolation of experimental data. (auth)

3111 (NASA-TN-D-1440) ON THE EFFECT OF HEAT ADDITION IN THE EMPIRICAL CORRELATION OF VOID FRACTIONS FOR STEAM-WATER FLOW. Uwe H. von Glahn and Richard P. Polcyn (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Nov. 1962. 37p.

An empirical equation is presented that closely approximates experimentally measured void fractions in steam-water flow with heat addition. Correlation of void fractions with heat addition is achieved through the use of steam quality, the ratio of the density of the fluid phases, a heat-addition parameter, and a fluid-property parameter. Void fractions without heat addition are also correlated by the proposed empirical equation. Correlation of data is achieved over a range of fluid pressures from 1 to 135 atmospheres and steam qualities from 0 to 1.0. (auth)

3112 (NBS-TN-122) A SURVEY OF THE LITERATURE ON HEAT TRANSFER FROM SOLID SURFACES TO CRYOGENIC FLUIDS. R. J. Richards, W. G. Steward, and R. B. Jacobs (National Bureau of Standards, Boulder, Colo.). Oct. 1961. 48p. (PB-161623)

A bibliography of 156 references on heat transfer from solid surfaces to fluids and related phenomena is presented. Heat transfer data obtained from experimental work on cryogenic fluids are presented in graphical form. The theoretical and empirical formulations appearing in the references are presented. In those cases where sufficient information is available to make numerical computations, the formulations are presented graphically to permit comparison with the results of the experimental work. (auth)

3113 (ORNL-TM-389) THE PRELIMINARY RESULTS OF A HEAT TRANSFER ANALYSIS AND FLUID FLOW EXPERIMENTS IN A VORTEX TUBE FLOW SYSTEM APPLICABLE TO A CIRCULATING-FUEL REACTOR CORE. N. D. Greene and H. F. Poppendiek (Oak Ridge National Lab., Tenn.). Oct. 4, 1962. Contract [W-7405-eng-26]. 37p.

A series of heat transfer and hydrodynamic experiments involving adaptation of a forced vortex to a unique fuel element system for reflector-moderated, circulating fuel reactors is discussed. Advances in circulating-fuel reactor design made possible by the development of the vortex tube flow system and hydrodynamic and heat transfer characteristics of such systems are examined. Results of calculations and studies are included. (J.R.D.)

3114 (TID-13276) TEMPERATURE DISTRIBUTION IN COUETTE FLOW WITH RADIATION. R. Viskanta and

R. J. Grosh (Argonne National Lab., Ill.). Apr. 1961. Contract [W-31-109-eng-38]. 11p. (UAC-5200)

Laminar Couette flow is considered. The radiant energy flux vector, which has an integral representation, is approximated by the Rosseland approximation, which is valid for intense absorption only. The solutions obtained are then compared with solutions obtained using exact formulations. (R.J.S.)

3115 (TID-14354) THE ISOTHERMAL TRANSITION FROM LAMINAR TO TURBULENT FLOW OF FLUIDS IN PIPES, CONCENTRIC ANNULI, AND PARALLEL PLATES. Richard W. Hanks (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1961]. Contract [W-7405-eng-26]. 18p.

A single criterion is presented which allows prediction of the transition from laminar to turbulent flow of fluids in geometries ranging from open pipes through concentric annuli to parallel plates. For the special case of Newtonian fluids herein treated, the criterion is uniquely related to the familiar Reynolds number. The theoretically determined dependence of the critical Reynolds number on the radius ratio r_1/r_2 for flow in concentric annuli exhibits a maximum value. This maximum value is N_{Re_c} (max) = 2461 which occurs at $r_1/r_2 = 0.15$. Experimental data for literature sources are compared with the theoretical curve and are found to be in good agreement with the predictions. In particular, the existence of maximum critical Reynolds number for annular flow is clearly shown by the data. (auth)

3116 (TID-16972) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report, September 1962. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Sept. 28, 1962. Contract AT(30-3)-187. 22p. (MPR-XIII-9-62)

Twenty-six instrumented burnout points were obtained using a solid tubular test section. This test section consists of a heater tube of 1.660 OD, 1.442 ID, 40 in. long, cooled on both surfaces and contained in a 2.50 in. ID outer housing tube. Variables studied include overall mass velocities at 0.5 to 2.3×10^6 lb/hr-ft^2, mixed fluid exit conditions between 42°F subcooled and 20% steam quality and average instrumented burnout heat fluxes as high as 1.3×10^6 Btu/hr-ft^2, all at a pressure of 1000 psia. The burnout data showed a very strong reverse mass velocity effect, i.e., for a constant exit quality raising the mass velocity resulted in a lower burnout heat flux. Flow measurements indicated that the percentage of the total flow going to the outer channel was a linearly decreasing function of the total flow rate near burnout. All the data were calculated on the basis of average and per channel conditions. (auth)

3117 (UCRL-9885) A THEORETICAL CONSIDERATION OF ASYMMETRIC HEAT FLOW AT THE INTERFACE OF THE DISSIMILAR METALS. Joon Sang Moon and R. N. Keeler (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1961. Contract W-7405-eng-48. 12p.

Several investigators have found that the resistance to heat transfer at certain metal-metal interfaces is dependent upon the direction of heat flow across these interfaces. It is shown that such a phenomenon can be explained by application of the theory of heat conduction in the solid state. (auth)

3118 (AWRE/Trans/32) DIFFUSION AT A FINITE SPEED. A. S. Monin. Translated by L. J. Goodlet (U.K.A.E.A. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Izv. Akad. Nauk SSSR, Ser. Geofiz., No. 3, 234-48(1955). 23p.

Turbulent diffusion is regarded as the result of action of current streams randomly distributed in the medium. Several types of such streams are distinguished, varying in the magnitude and direction of the flow velocity. It is assumed that the coordinate of a diffusing particle and the number of the stream in which it is situated form a Markov random process. If only two types of streams are present, differing in the direction of the flow velocity, the diffusion can be described by a telegraph equation. (auth)

3119 THE EFFECT OF THE TEMPERATURE-DEPENDENT MATERIAL PROPERTIES ON THE TEMPERATURE FIELD IN THE COOLANT STREAM AT THE OUTLET FROM THE FISSION ZONE. R. Pruschek (Arbeitsgruppe für Reaktorphysik, Stuttgart). Atomkernenergie, 7: 305-11(Sept. 1962). (In German)

The influence of the temperature dependent material properties on the temperature distribution in the coolant at the outlet of a cylindrical core is shown. Coolant channels and fuel elements are assumed to be equal. The temperature dependent material properties under reactor conditions (turbulent flow) have an unfavorable effect, i.e., the temperature increases in the middle of the stream at the core exit. This is true in particular for gas-cooled reactors with high temperature rise in the coolant between inlet and outlet. As a rule, in most power reactors the unfavorable temperature distribution caused by the flux distribution is prevented by orifices installed in the coolant channels. By this measure the coolant mass flux can be controlled in each coolant channel according to the heat generation of the fuel element. However this method is not applicable in pebble-bed reactors. The conditions in this case are demonstrated numerically by means of an example. (auth)

3120 TWO-PHASE (GAS-LIQUID) FLOW PHENOMENA. IV. EXPERIMENTAL STUDY OF WATER EVAPORATION IN A VERTICAL TUBE. G. H. Anderson, G. G. Haselden, and B. G. Mantzouranis (Imperial Coll., London). Chem. Eng. Sci., 17: 751-69(Oct. 1962).

An apparatus for the measurement of heat-transfer coefficients to water boiling in a vertical tube is described. The experimental data include values of the variation of temperature difference and pressure gradient along the tube and some measurements of entrainment. These data are discussed in the light of the theory developed in Parts I, II and III of this series. (auth)

3121 TAP LOCATION FOR SEGMENTAL ORIFICES. Daniel Shichman and Ben S. Johnson, Jr. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Instr. Control Systems, 35: No. 4, 102-5(Apr. 1962).

Flowmeter taps used in conjunction with a segmental orifice should be oriented at least 20° circumferentially away from the open area of the orifice plate. Taps in line with the open area (θ) result in low and erratic meter readings; the error increases as the tap spacing decreases from the "vena contracta taps" location. (auth)

3122 HEAT TRANSFER AT THE INTERFACE OF DISSIMILAR MATERIALS: EVIDENCE OF THERMAL-COMPARATOR EXPERIMENTS. R. W. Powell, R. P. Tye, and B. W. Jolliffe (National Physical Lab., Teddington, Middx., Eng.). Intern. J. Heat Mass Transfer, 5: 897-902 (Oct. 1962). (In English)

A recent publication has drawn attention to a marked directional dependence of the heat flow at the interface of certain contacting metals, and considers the effect to be associated with the mechanism of conduction at the points of metallic contact. The effect is investigated in terms of the reading of a thermal comparator having initial tem-

peratures both above and below that of the test sample. No such directional difference is found in this way for the metal combinations for which the effect had previously been reported, namely steel and aluminium, and steel and aluminium alloy, nor is any difference found for the combinations of a metal (steel) with either a semiconductor (germanium) or an electrical insulator (a ceramic material based on soapstone), for which it is to be expected that differences in the heat conduction mechanism would be more pronounced. It is concluded that the use of the thermal comparator for thermal conductivity determinations is not complicated by any such directional effect. (auth)

3123 FILM CONDENSATION IN A FORCED-CONVECTION BOUNDARY-LAYER FLOW. J. C. Y. Koh (Boeing Co., Seattle). Intern. J. Heat Mass Transfer, 5: 941-54 (Oct. 1962). (In English)

Laminar film condensation of a saturated vapor in forced flow over a flat plate is analyzed. The problem is formulated as an exact boundary-layer solution. From numerical solutions of the governing equations, it is found that the energy transfer by convection is negligibly small for low Prandtl number liquids (liquid metals) but quite important for high Prandtl number liquids. The condensation rate, skin friction, and heat transfer are presented in graphs as a function of $c_p\Delta T/Prh_{fg}$ with $[(\rho\mu)_L/(\rho\mu)_v]^{1/4}$ and Pr as parameters. (auth)

3124 HEAT TRANSFER IN THE THERMAL ENTRY LENGTH WITH LAMINAR FLOW IN AN ANNULUS. A. P. Hatton and A. Quarmby (Manchester Coll. of Science and Tech., Eng.). Intern. J. Heat and Mass Transfer, 5: 973-80(Oct. 1962). (In English)

The solution to the Graetz problem in an annulus with a heated core and an insulated outer wall is presented. Both uniform temperature and uniform heat input on the inside wall are considered for a number of arbitrarily chosen radius ratios. The case of parallel plates with one side insulated is included for comparison. The solution is extended to certain cases of axial variation of the core heat input and to the case in which heat is transferred at uniform but unequal rates at both walls. (auth)

3125 EXPERIMENTS ON POOL-BOILING HEAT TRANSFER. P. J. Berenson (AiResearch Mfg. Co., Los Angeles). Intern. J. Heat Mass Transfer, 5: 985-99(Oct. 1962). (In English)

The characteristic pool-boiling curve was measured for n-pentane at atmospheric pressure as a function of surface roughness, material and cleanliness. The maximum nucleate-boiling heat flux and the film-boiling curve were independent of surface conditions. The nucleate-boiling heat-transfer coefficient varied by 600 per cent owing to variations in surface finish. It was concluded that transition boiling is a combination of unstable nucleate and unstable film boiling alternating at any location on the heating surface. The transition-boiling heat-transfer data plotted as log (q|A) vs. log (ΔT) was found to be correlated by a straight line connecting the maximum and minimum heat flux points. (auth)

3126 HEAT TRANSFER, A REVIEW OF CURRENT LITERATURE. E. R. G. Eckert, T. F. Irvine, Jr., E. M. Sparrow, and W. E. Ibele (Univ. of Minnesota, Minneapolis). Intern. J. Heat Mass Transfer, 5: 1023-50(Oct. 1962). (In English)

Results of research on heat transfer published during the foregoing year are reviewed. The review is divided into sections dealing with the following subjects: conduction, channel flow, boundary-layer flow, flow with separated regions, transfer mechanisms, natural convection, convection from rotating surfaces, combined heat and mass transfer, phase changes, radiation, liquid metals, low-density heat transfer, measurement techniques, heat-transfer applications, and thermodynamic and transport properties. A bibliography of 508 references, arranged according to the above subjects, is given. (D.L.C.)

3127 ON SHEAR FLOW PAST FLAT PLATES. Richard M. Mark (Lockheed Research Lab., Palo Alto, Calif.). J. Fluid Mech., 14: 452-62(Nov. 1962).

The boundary layer on a semi-infinite flat plate placed in a two-dimensional, unbounded, steady, constant shear flow of a viscous incompressible fluid is examined on the basis of the constant-pressure assumption. An asymptotic solution is obtained first, for large vorticity numbers. An approximate solution is then found for arbitrary vorticity numbers that gives good agreement with exact calculations for the extreme cases of small and large vorticity numbers. The calculations are limited to the boundary layer on the top side of the plate only. (auth)

3128 ON THE HYDRODYNAMIC AND HYDROMAGNETIC STABILITY OF SWIRLING FLOWS. Louis N. Howard (Massachusetts Inst. of Tech., Cambridge) and A. S. Gupta. J. Fluid Mech., 14: 463-76(Nov. 1962).

Some general stability criteria for non-dissipative swirling flows are derived, and extended to the case of an electrically conducting fluid in the presence of axial magnetic field and current. In particular, it is shown that the analogy between a rotating and a stratified fluid holds in this case, and that an important determinant of stability is a "Richardson number" based on the analog of the density gradient and the shear in the axial flow. (auth)

3129 ON THE STABILITY OF FLAT PLATES UNDER THE INFLUENCE OF COOLANT FLOW. J. Schloesser (OECD High Temperature Reactor Project, Winfrith, Dorchester, Dorset, Eng.). J. Nucl. Energy Pt. A and B, 16: 351-4(July 1962).

The mechanical stability of a flat plate between two solid walls under the influence of a coolant flow is investigated. The effects of fluid friction are allowed for, but the effects of non-uniform temperature are neglected. The system is found to possess a critical coolant velocity, above which the plate collapses. (auth)

3130 NEUTRON-ACTIVATION FLOWMETER. William A. Jester (Pennsylvania State Univ., University Park). Nucleonics, 20: No. 11, 72; 74-5(Nov. 1962).

For heat transfer studies, an activation method was developed for measuring low natural-convection coolant flow through individual fuel channels in a 200-kw swimming-pool reactor. In this method, the activity induced in the coolant by passing through the core is measured and used to give an indication of the flow rate. The performance of the flowmeter was studied. Curious slow increases and decreases in sampled-water activity during equilibrium conditions were observed which are thought to be due to changing neutron flux. (D.L.C.)

3131 END CORRECTION FOR SLOW VISCOUS FLOW THROUGH LONG TUBES. Harold L. Weissberg (Oak Ridge Gaseous Diffusion Plant, Tenn.). Phys. Fluids, 5: 1033-6 (Sept. 1962).

A variational method valid for the creeping-flow regime is used to calculate an upper bound for the pressure drop associated with viscous dissipation near the ends of a long round tube. The result states that this pressure drop, which is an additive correction to that given by the Poiseuille formula, is not greater than 1.154 times the pressure drop through a thin orifice. The orifice pressure drop, in terms of the fluid viscosity μ, the volumetric flow rate Q, and the

radius a, is found to be $3\mu Q/a^3$, in confirmation of a previous calculation of Roscoe by a different method. (auth)

3132 THE ABLATION OF GRAPHITE IN DISSOCIATED AIR. PART I: THEORY. Sinclaire M. Scala (General Electric Co., Philadelphia). Preprint R62SD72. Philadelphia, General Electric Co., 1962. Publication Copy. 89p.

An analysis is presented of the combustion of graphite in a high speed stream of dissociated air. Many features of the analysis are quite general and may be applied to the oxidation of different materials in arbitrary chemically reactive environments. Numerical results, which are directly applicable to surface oxidation at the leading edge region of fins and wings, and the nose cap of axially-symmetric hypersonic vehicles, are also presented. The reaction rate controlled regime and the transition regime are first considered at length, and it is shown how the grade of graphite and its specific chemical properties influence the over-all oxidation rate. It is then shown how the governing equations of change may be reduced to a coupled set of non-linear differential equations of the fifteenth order with variable coefficients and split boundary conditions. The differential equations were then utilized in treating the laminar, compressible, multicomponent, chemically reacting boundary layer in the diffusion controlled regime, and solutions are obtained for both the equilibrium and frozen gas flow chemical constraints. Numerical results were obtained on an IBM 704 digital computer, and correlated results were obtained for the heat transfer rate, the mass transfer rate, and the skin friction coefficient for the complete range of suborbital hypersonic flight conditions of interest. In addition, in order to establish a better understanding of the complex physicochemical processes which occur, many details of the structure of the boundary layer, including the variation of macroscopic gas velocity, gas temperature, chemical composition, and chemical source terms through the boundary layer, are presented. (auth)

3133 THE ABLATION OF GRAPHITE IN DISSOCIATED AIR—EXPERIMENTAL INVESTIGATION. N. S. Diaconis, P. D. Gorsuch, and R. A. Sheridan (General Electric Space Sciences Lab., Philadelphia). Preprint No. R62SD86. Prepublication Copy. 33p.

An experimental investigation was conducted to study the oxidation performance of ATJ graphite in dissociated air. For good experimental simulation it was desirable to establish in the test facility at least the following: stagnation enthalpy of the gas stream, model pressure, flow chemistry, and aerodynamic shear. Tests were conducted in a hypersonic arc wind tunnel in which the material mass loss was correlated as a function of model surface temperature. The data obtained indicated two specific zones of material performance, one in which the rate of the reaction between the oxygen species and the material governed the mass loss and the other in which the rate of diffusion of the oxygen-bearing species to the surface was dominant. Comparison of the experimental data with the theory of Scala showed good agreement. (auth)

Materials Testing

Refer also to abstract 3714.

3134 (HW-SA-2801) A PROGRAM TO ESTIMATE MEASUREMENT ERROR IN NONDESTRUCTIVE EVALUATION OF REACTOR FUEL ELEMENT QUALITY. J. L. Jaech (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 10, 1962. Contract AT(45-1)-1350. 30p.

A program to evaluate sources of error contributing to a total measurement error in nondestructive testing of reactor fuel elements is described. The mathematical model used to describe the error structure is discussed. Methods used to estimate the parameters of the model are outlined. The techniques used in comparing various instruments with respect to precision and accuracy and in estimating the error components contributing to total error are described. An example is given using computer output. (M.C.G.)

3135 (ORNL-TM-166) COLLAPSE OF TUBES BY EXTERNAL PRESSURE. C. R. Kennedy and J. T. Venard (Oak Ridge National Lab., Tenn.). Apr. 17, 1962. Contract W-7405-eng-26. 30p.

The problem of tube collapse by external pressure has been investigated experimentally. A graphical solution developed to simplify inelastic collapse design problems was shown to agree with the test results. The von Karman reduced modulus was used in the graphical solution to correct for the stress redistribution caused by yielding. The effects of the geometric imperfections of ovality and wall thickness variations on collapse pressure were shown to be related to the stress-strain behavior of the material. The concept of a "critical time" was discussed in regard to creep-buckling phenomenon. (auth)

3136 (TID-15452) CRUSHING STRENGTH DETERMINATION OF ROUNDED CERAMIC PARTICLES. R. E. Mistler, A. T. Muccigrosso, and F. W. Wiesinger (Knolls Atomic Power Lab., Schenectady, N. Y.). [May 1, 1962]. Contract W-31-109-Eng-52. 19p.

A test was performed to further define the mechanical properties of rounded ceramic particles. This test involves the measurement of the strength of individual particles under a compressive load using a standard compression-testing apparatus. An average of several crush strength determinations is used to assign a compressive strength value to each material tested. The materials used were glass beads, SiO_2 particles, ZrO_2 spheres, and Al_2O_3 spheres. The test was designed to investigate various test parameters that affect crush strength values. It was found that considerable variation resulted from the use of anvil materials which differed in hardness, i.e., tungsten carbide, sapphire, and hardened steel. The crush strength of particles of a single material was found to vary with shape and size. Particles with spherical shapes produce higher crush strength values than those with rounded or egg shapes. The spherical particles crush under a nearly perfect axial compressive load whereas rounded particles are exposed to a shear component. Larger diameter particles of a given material crush under higher loads than smaller particles of the same material. It is believed that this is due to the lower load per unit area on the larger particles. Typical results for each material are presented graphically including crush strength charts, comparison of shape factors, and particle diameters. (auth)

3137 TESTING FILTER MEDIA. Fritz Rosenthal. Instr. Control Systems, 35: No. 4, 111-12 (Apr. 1962).

A new method for testing filters uses the gamma radiation from radioactive particles. The radiation of an irradiated powder accumulating on a filter specimen is monitored by a "probe" and recorded on a count rate meter. (auth)

3138 NONDESTRUCTIVE FUEL ASSAY AT NRTS. Fred H. Tingey (Phillips Petroleum Co., Idaho Falls, Idaho). Nucleonics, 20: No. 7, 76; 78-81 (July 1962).

The characteristics of a gamma-scanning system for assaying the U^{235} in unirradiated fuel plates are described. A fast-neutron-attenuation method is also discussed. The system is capable of detecting segregation and inhomogeneities in the fuel loading. (T.F.H.)

3139 COLOR RADIOGRAPHY. Georg S. Mittelstaedt. U. S. Patent 3,061,722. Oct. 30, 1962.

A device has been developed for stopping visible light between light sensitive layers while allowing all intensities of x rays to pass through. The principles of this device may be applied to all fields of radiography. (R.J.S.)

3140 SYSTEM FOR ULTRASONIC INSPECTION OF TUBULAR OBJECTS. J. A. Kaserman and R. B. Oliver (to U. S. Atomic Energy Commission). U. S. Patent 3,063,290. Nov. 13, 1962.

A system is designed for ultrasonic testing of a pipe submerged in a liquid bath. Flaws are detected by progressively scanning the rotating pipe while it is supported along its length by a series of spaced moving guides. (D.L.C.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstracts 2719, 2720, 2903, 3651, 3652, 3653, 3655, 3656, 3657, 3658, 3664, and 3672.

3141 (AD-273451) APPLICATION OF WEATHER RADAR TO FALLOUT PREDICTION. Quarterly Technical Report No. 15, September 1, 1961–November 30, 1961. Pauline M. Austin (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). Contract DA-36-039 SC-75030. 12p.

Computations on the fallout pattern for a 10 KT detonation and its modification by precipitation yielded useful results concerning the manner in which the radioactive cloud diffuses in the atmosphere. The analysis is discussed briefly. A comparison of the rainfall amounts as measured by the radar and by a network of rain gauges has been made for a particular storm. The accuracy of the radar data cannot be definitely ascertained, but it is clear that the rain-gauge network underestimated the rainfall by a significant amount. (auth)

3142 (AD-274106) DEEP-BOREHOLE SEISMIC RESEARCH. VESIAC Special Report. Louise Snider (Michigan. Univ., Ann Arbor. Inst. of Science and Tech.). Mar. 1962. Contract SD-78. 89p.

A compilation of status reports on the deep borehole research program by VELA UNIFORM contractors is presented. Detailed information is given on instrumentation, seismic measurements, buried arrays, ocean-bottom seismometers, and the United Kingdom borehole program. Diagrams, charts, and other illustrative material is included. Recommendations for future work are given by some authors. (auth)

3143 (AD-276185) CORRECTING CERTAIN WIND STATISTICS FOR BIAS. Robert R. Read (California. Univ., Berkeley. Inst. of Engineering Research). Feb. 15, 1961. Contract CD-SR-58-40. 44p.

Estimates of the parameters of wind statistics are needed to improve the techniques of fallout prediction. Corrections for biases due to the fact that the raw data are reported in polar coordinates and the fact that wind observations are not independent are presented. The biases for winter winds at Oakland have been computed as an illustration of the magnitudes. (auth)

3144 (AFSWC-TDR-62-35) REENTRY AND DISPOSAL PHENOMENA FOR NUCLEAR AUXILIARY POWER SYSTEMS: COMPILATION OF ATMOSPHERIC PARAMETERS OF INTEREST. E. Philbin and M. Downing (General Dynamics/Astronautics, San Diego, Calif.). Mar. 1962. Contract AF29(601)-4893. 20p. (AD-274477)

Data on the variation of atmospheric physical properties with respect to altitude are presented. Information on prevailing winds, necessary in computing the diffusion of burnup debris, is also included. (auth)

3145 (BNL-5554) POTASSIUM–ARGON AGES OF VOLCANICS NEAR GRANTS, NEW MEXICO. W. A. Bassett, P. F. Kerr, O. A. Schaeffer, and R. W. Stoenner (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 19p.

Six potassium-bearing specimens from Grants Mesa, a youthful volcanic complex just north of Grants, N. Mex., yield age determinations which date one of the several recognized periods of volcanic activity. Obsidian masses along the north side of the mesa are dated at 3.3 ± 0.5 million years. Perlite now being mined in an open pit along the northeast edge of the mesa corresponds with the obsidian in age. Plagioclase from an andesitic plug which pierces the mesa contains only 0.43% potassium. Two determinations made on the plagioclase give 4 and 9 million years. These are considered doubtful because of the low potassium content. The perlite, a porous, hydrous glass, contains no more air argon than the massive vitreous obsidian. Thus, preliminary observations suggest that meteoric water, which would be expected to introduce air argon, is not responsible for the hydration of the perlite. The porosity and high water content of the perlite, which give it the commercially valuable property of expanding when heated, are believed to have resulted from magmatic or hydrothermal hydration. Metamorphosed Todilto limestone (Jurassic), found in the Section 33 mine beneath the lava on the mesa, contains uranium which has been dated on a single unconfirmed determination at 78 ± 5 million years by Miller and Kulp. Investigation of the nearby sequence of volcanic rocks has been undertaken as an initial step in an effort to obtain definitive age data on the environment of the uranium occurrence. (auth)

3146 (BNL-6000) INVESTIGATIONS OF THE POTASSIUM–ARGON METHOD OF AGE DETERMINATION USING SOLID ISOTOPIC DILUTION AND GAS REMOVAL BY CRUSHING. John J. Naughton (Brookhaven National Lab., Upton, N. Y. and Hawaii. Univ., Honolulu). [1961]. Contract [AT(30-2)-Gen-16]. 12p.

Preliminary work on a new technique of isotopic dilution analysis useful in the measurement of radiogenic Ar content of rocks or mineral samples in age determination is reported. Argon-38 is added to the samples as the diluting isotope dissolved in a solid glassy silicate which approximates the pertinent properties of the sample. Crushing as well as melting can be used to extract the representative portion of gas needed to apply the isotopic dilution method. In the preliminary investigations order-of-magnitude agreement was obtained with the Ar content of samples determined by conventional techniques. The possibilities of the method include elimination of uncertainties about complete extraction of Ar from samples, use of radioactive counting of argon-39 as a determinative technique, and preferential removal of air contamination by crushing to enable extension of the K-Ar method to younger ages. (auth)

3147 (CEA-2144) MESURES JOURNALIERES DE LA RADIOACTIVITE NATURELLE ET ARTIFICIELLE DANS L'AIR EN 1961. (Daily Measurements of Natural and Artificial Radioactivity in 1961). J. Cl. Philippot (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1962. 28p.

Data are tabulated on daily results of measurements of β activity in the air at 10 stations in France during 1961. The activity included that from both natural and artificial sources. The results are expressed as $\mu\mu c/m^3$ of air. (C.H.)

3148 (HW-71400(Vol.2)) THE GREEN GLOW DIFFUSION PROGRAM. VOLUME II. Geophysical Research Papers No. 73. Morton L. Barad and James J. Fuquay, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1962. Contract AT(45-1)-1350. 305p. (AFCRL-62-251(II))

Tabulations of the diffusion data and meteorological data that were collected during GREEN GLOW, which was a

field investigation aimed at providing experimental data on the diffusion of an aerosol over a 16-mile range, are presented. The experiments were conducted at night during the Summer of 1959 on the U. S. Atomic Energy Commission's Hanford reservation near Richland, Washington. (auth)

3149 (LAMS-2760) EQUATION OF STATE OF NEVADA ALLUVIUM. R. G. McQueen and S. P. Marsh (Los Alamos Scientific Lab., N. Mex.). Nov. 1961. Contract W-7405-eng-36. 13p.

Procedures and results are set forth for Hugoniot measurement of two samples of Nevada alluvium. Two shot records shown are typical of high and low pressure shots. (R.J.S.)

3150 (NP-12194) VELA-UNIFORM—DYNAMIC PROPERTIES OF ROCKS. Semiannual Technical Report No. 2. V. G. Gregson and D. R. Grine (Stanford Research Inst. Poulter Labs., Menlo Park, Calif.). Apr. 20, 1962. Contract AF 19(604)-8419. 122p.

A program to measure properties of rocks and minerals under shock conditions is described. The research is directed toward the pressure region in which the strength of the rock affects the shock wave. The property that is measured is the Hugoniot equation of state. The minerals of interest are quartz and calcite. Results of the investigation indicate that a two-wave front occurs in both materials. It was also found that there is a difference in values for the Hugoniot equation of state in crystals and in polycrystalline rock. Data and discussion of the experiments are included. (J.R.D.)

3151 (NP-12275) BOBAC. Long Range Seismic Measurements [of] VELA UNIFORM Project 8.4. (Geotechnical Corp., Garland, Tex.). Aug. 24, 1962. 35p.

Seismic data recorded from the BOBAC event by the Long Range Seismic Measurements (LRSM) Program established under VELA UNIFORM Project 8.4 are analyzed. This program was established to record and analyze short-period and long-period seismic data from a planned series of United States underground nuclear tests. (R.J.S.)

3152 (NP-12276) HAYMAKER. Long Range Seismic Measurements [of] VELA UNIFORM Project 8.4. (Geotechnical Corp., Garland, Tex.). June 27, 1962. 42p.

Seismic data recorded from the HAYMAKER event by the Long Range Seismic Measurements (LRSM) Program established under VELA UNIFORM Project 8.4 are analyzed. This program was established to record and analyze short-period and long-period seismic data from a planned series of United States underground nuclear tests. (R.J.S.)

3153 (NP-12277) YORK. Long Range Seismic Measurements [of] VELA UNIFORM Project 8.4. (Geotechnical Corp., Garland, Tex.). Aug. 24, 1962. 34p.

Seismic data recorded from the YORK event by the Long Range Seismic Measurements (LRSM) Program established under VELA UNIFORM Project 8.4 are analyzed. This program was established to record and analyze short-period and long-period seismic data from a planned series of United States underground nuclear tests. (R.J.S.)

3154 (NP-12278) WICHITA. Long Range Seismic Measurements [of] VELA UNIFORM Project 8.4. (Geotechnical Corp., Garland, Tex.). July 27, 1962. 34p.

Seismic data recorded from the WICHITA event by the Long Range Seismic Measurements (LRSM) Program established under VELA UNIFORM Project 8.4 are analyzed. This program was established to record and analyze short-period and long-period seismic data from a planned series of United States underground nuclear tests. (R.J.S.)

3155 (TEI-823) GEOLOGY OF THE POWDER RIVER BASIN, WYOMING AND MONTANA, WITH REFERENCE TO SUBSURFACE DISPOSAL OF RADIOACTIVE WASTES. Helen M. Beikman (Geological Survey, Washington, D. C.). Feb. 1962. 94p.

The Powder River Basin is a structural and topographic basin occupying an area of about 20,000 square miles in northeastern Wyoming and southeastern Montana. The Basin is about 230 miles long in a northwest-southeast direction and is about 100 miles wide. It is bounded on three sides by mountains in which rocks of Precambrian age are exposed. The Basin is asymmetrical with a steep west limb adjacent to the Bighorn Mountains and a gentle east limb adjacent to the Black Hills. Sedimentary rocks within the Basin have a maximum thickness of about 18,000 feet and rocks of every geologic period are represented. Paleozoic rocks are about 2500 feet thick and consist of marine carbonate rocks and sandstone; Mesozoic rocks are about 9500 feet thick and consist of both marine and nonmarine siltstone and sandstone; and Cenozoic rocks are from 4000 to 6000 feet thick and consist of coal-bearing sandstone and shale. Radioactive waste could be stored in the pore space of permeable sandstone or in shale where space could be developed. Many such rock units that could be used for storing radioactive wastes are present within the Powder River Basin. Permeable sandstone beds that may be possible reservoirs for storage of radioactive waste are present throughout the Powder River Basin. These include sandstone beds in the Flathead Sandstone and equivalent strata in the Deadwood Formation, the Tensleep Sandstone and equivalent strata in the Minnelusa Formation, and the Sundance Formation in rocks of pre-Cretaceous age. However, most of the possible sandstone reservoirs are in rocks of Cretaceous age and include sandstone beds in the Fall River, Lakota, Newcastle, Frontier, Cody, and Mesaverde Formations. Problems of containment of waste such as clogging of pore space and chemical incompatibility would have to be solved before a particular sandstone unit could be selected for waste disposal. Several thick sequences of impermeable shale such as those in the Skull Creek, Mowry, Frontier, Belle Fourche, Cody, Lewis, and Pierre Formations, occur in rocks of Cretaceous age in the Basin. Limited storage space for liquid waste might be developed in impermeable shale by fracturing the shale and space for calcined or fused waste could be developed by mining cavities. (auth)

3156 (TEI-832) GAMMA-RADIOACTIVITY INVESTIGATIONS AT THE NEVADA TEST SITE, NYE COUNTY, NEVADA. Interim Report, February 1960–July 1961. Carl M. Bunker and Marvin D. Shutler (Geological Survey, Washington, D. C.). Oct. 1962. 68p.

As a part of continuous geologic and geophysical investigations at the Nevada Test Site, gamma-radioactivity measurements are being made in tunnels and drill holes to determine semiquantitatively the natural gamma radioactivity of geologic formations and the distribution of nuclear-explosion-produced radioisotopes. Tunnel walls were surveyed with portable scintillation detection equipment and drill holes were logged with Geiger-Mueller detectors. These measurements were started in 1957 and have continued to date; however, only the results of studies between February 1960 and July 1961 are reported here. The natural gamma radioactivity was measured in tuff, alluvium, marble, dolomite, and granite. The highest natural radioactivity was measured in granite; the lowest natural radioactivity was in marble and dolomite. Gamma-ray logs of drill holes generally show contacts between rock types

by changes in radioactivity at contacts, location of water level, and location of casing. Gamma-radioactivity surveys in tunnels seldom show contacts between the types of tuff exposed in the tunnels. Measurements of nuclear-explosion-produced radioactivity show the distribution of gamma-emitting radioisotopes around the locations of the explosions. Surveys show that explosion products are disseminated through fractures and faults, and they also show the relative efficiency of stemming in the tunnels. Inefficient stemming may permit contamination of sections of the tunnels otherwise unaffected by nuclear explosions, and the resulting contamination may partly invalidate measurements of natural gamma radioactivity. (auth)

3157 (TID-16988) UPPER ATMOSPHERE MONITORING PROGRAM. Rex C. Wood (General Mills, Inc., Minneapolis). Jan. 1, 1962. Contract AT(11-1)-401. 189p.

Separate abstracts were prepared for 7 sections of this report covering the development of equipment for sampling radioactive particles in the upper atmosphere. (C.H.)

3158 (TID-16988(Paper 1)) HIGH ALTITUDE PARTICLE AND GAS SAMPLING PROBE MATED TO A LIQUID NITROGEN-COOLED ADSORBENT PUMP. S. F. Rohrbough, J. E. Upton, and P. D. Stroom (General Mills, Inc., Minneapolis). 49p.

Problems are discussed that are encountered in the design of sampling systems for gases and particles capable of operating at altitudes higher than 100,000 ft. A high-capacity liquid-nitrogen-cooled adsorbent pump was designed to replace motors and blowers. This pump utilizes adsorption processes to pull air through a filter in sufficient quantities to allow radiometric and radiochemical analysis of the particles collected. Recovery of gases adsorbed on a separate crystalline zeolite pre-bed offers a means for studying the gaseous composition of the upper atmosphere. Experimental studies, fabrication, and ground tests are described and a schematic diagram of the adsorbent pump sampling system is presented. (C.H.)

3159 (TID-16988(Paper 2)) FEASIBILITY STUDY OF NON-RADIOACTIVE TRACERS FOR USE IN DETERMINING ATMOSPHERIC CIRCULATION PATTERNS. Dale A. Lundgren and Rex C. Wood (General Mills, Inc., Minneapolis). 28p.

Results are reported from a preliminary investigation of the use of non-radioactive materials as tracers in continental or global air mass studies. It was concluded that particulate fluorescing organic compounds and ultraviolet detection may be suitable for use on a continental scale and particulate tracers of neutron-activated elements may be suitable for studies of global circulation. A list of candidate materials was compiled for each method. Methods of aerosol production, collection, and detection are included for each material. The effects of environmental factors and fall-out particulates on results are discussed. (C.H.)

3160 (TID-16988(Paper 3)) DEVELOPMENT OF HIGH VOLUME AEROSOL SAMPLING SYSTEM FOR FIELD OPERATIONS. R. C. Wood and W. L. Torgeson (General Mills, Inc., Minneapolis). 37p.

The development of high-volume aerosol sampling systems for upper air sampling programs is reviewed. Design and performance data are summarized for the Ashcan system, a direct-flow filter sampler, and the AFCRL submicron aerosol collector. Basic design requirements of a field operational particle sampling system are outlined and results are reported from intercomparisons of several systems. Factors leading to the choice of the Direct Flow Sampler for development are discussed. This high-volume aerosol sampling system utilizes direct flow, an air flow meter, and IPC-1478 filter paper. Complete design and performance data are included. (C.H.)

3161 (TID-16988(Paper 4)) DEVELOPMENT OF AN OPERATIONAL TEMPERATURE TELEMETERING SYSTEM FOR USE WITH BALLOON-BORNE SAMPLING EQUIPMENT. John W. Borth (General Mills, Inc., Minneapolis). 10p.

A temperature telemetering system employing transistor circuits was developed for use with balloon-borne high-altitude air sampling equipment. Temperature data from flowmeters are combined with rpm information and channeled through a single telemetry transmitter. Measurements of temperature in the flowmeter result in more accurate determinations of air volume. (C.H.)

3162 (TID-16988(Paper 5)) EXPERIMENTAL RESEARCH FLIGHT PROGRAM. Rex C. Wood (General Mills, Inc., Minneapolis). 18p.

Dual-balloon step flights were performed in 1961 to obtain vertical profiles of radioactive debris in the stratosphere and also to test new equipment. Two balloons, each carrying two Direct Flow Samplers, were used. The first balloon system ascended to 70,000 ft where sampling commenced with one unit. Approximately 75 min after launch of the first flight, and before sampling began at 70,000 ft, a second balloon system was launched. This balloon ascended to an initial sampling altitude of 50,000 ft. Sampling at 50,000 and 70,000 ft occurred almost simultaneously. After sampling was completed at 50,000 and 70,000 ft, ballast was dropped from both systems, and altitudes of 60,000 and 80,000 ft were obtained. Sampling then took place at these altitudes. At the end of the sampling periods the loads were returned by parachute. Flight data are tabulated. Data are included on observed vertical profiles of Cs^{137}, Sr^{90}, Ce^{144}, and total β activity of the samples. Results are compared with those obtained from filter profile and impactor profile flights. Results of these flight tests indicate that the improved Direct Flow Samplers can operate at high altitude for extended sampling periods. Some data are also included on the performance of electrostatic precipitators tested on some flights. (C.H.)

3163 (TID-16988(App.A)) TWO METHODS FOR ESTIMATING THE SIZE OF RADIOACTIVE PARTICULATES. S. P. Jones, I. Hall, and R. C. Wood (General Mills, Inc., Minneapolis). 14p.

Data from cascade impactors and filter samples were used to determine the mass median particle diameter of radioactive aerosols collected during high-altitude balloon flights. Procedures are described for both methods. The data indicate an apparent trend toward larger particle size with time. (C.H.)

3164 (TID-16988(App.B)) A STUDY OF FILTRATION MECHANISMS. W. L. Torgeson (General Mills, Inc., Minneapolis). 32p.

A filter study program was carried out to investigate the physical mechanisms responsible for collection of particulate material by fibrous filters. Results are reported from a number of experimental studies. A useful theory was developed for predicting the performance of fibrous filters. (C.H.)

3165 (TID-17087) PROGRESS REPORT [ON SAMPLING RADIOACTIVE DEBRIS], AUGUST–SEPTEMBER 1962. Rex C. Wood and Sam P. Jones (General Mills, Inc., Minneapolis). Oct. 12, 1962. Contract AT(11-1)-401. 15p.

Balloon flights to sample radioactive debris at 70,000 and 80,000 ft were accomplished by using a gondola equipped with two direct-flow units and ballast to float

the system at the lower of the two altitudes. After sampling was completed at the lower level the ballast was dropped and the system ascended. The flight system and components used are shown in a sketch. Data are tabulated. An experimental study was continued on jet impactors for use in collecting particles above 100,000 ft. Results indicate that a multiple jet impactor of the type and configuration tested has essentially the same characteristics as a single jet impactor. (C.H.)

3166 (TID-17090) STRONTIUM-90 ON THE EARTH'S SURFACE. II. SUMMARY AND INTERPRETATION OF A WORLD-WIDE SOIL SAMPLING PROGRAM: 1960–1961 RESULTS. Edward P. Hardy, Jr. (New York Operations Office. Health and Safety Lab., AEC); Robert J. List, Lester Machta (Weather Bureau, Washington, D. C.); Lyle T. Alexander, James S. Allen, and Milton W. Meyer (Department of Agriculture. Soil Survey Labs., Beltsville, Md.). Nov. 1962. 21p.

Radiochemical determination of strontium-90 content in soil samples collected on a world-wide scale in 1960–1961 is reported. The analytical methods used are described. Results are tabulated and interpreted. (R.J.S.)

3167 (TID-17224) GEOLOGICAL, GEOPHYSICAL, AND HYDROLOGICAL INVESTIGATIONS OF THE SAND SPRINGS RANGE, FAIRVIEW VALLEY, AND FOURMILE FLAT, CHURCHILL COUNTY, NEVADA FOR SHOAL EVENT, PROJECT SHADE, VELA UNIFORM PROGRAM, ATOMIC ENERGY COMMISSION. (Nevada Bureau of Mines, Reno; Nevada Mining Analytical Lab., Reno; and Nevada. Univ., Reno. Desert Research Inst.). 1962. 132p.

To help evaluate the Sand Springs Range as a site for the Atomic Energy Commission's proposed 5 kiloton underground nuclear Shoal Event, the University of Nevada has completed an exploration program begun late in November 1961. Elements of this program included bulldozer work, engineering control, aerial photography, preparation of photomosaics and topographic maps, geological mapping at three different scales, mineralogical studies, age determinations, diamond drilling of two test holes in granite, a gravity survey, an aeromagnetic survey, a refraction survey, certain physical tests on the core, study of the hydrology of the Range and the surrounding alluvium, drilling and study of four hydrological test holes in the alluvium, and study of hydrological conditions of the two holes in granite. With some reservation because of limited knowledge of all requirements for the experiment, it was concluded from exploration results and consideration of those safety factors related to geology that the Sand Springs Range is suitable for the Shoal Event. The site may be somewhat more complicated by joints, cleavage, faults, dikes, and water than was realized when it was selected for more detailed study, but the exploration results should not be surprising for an area so active seismically. (R.J.S.)

3168 (TID-17224(Suppl.)) [SAND SPRINGS RANGE, CHURCHILL COUNTY, NEVADA. MAPS AND PHOTOGRAPHS]. (Nevada Bureau of Mines, Reno; Nevada Mining Analytical Lab., Reno; and Nevada. Univ., Reno. Desert Research Inst.). [1962]. 12p.

Geophysical logs and the geologic log of diamond drill hole ECH-D, Sand Springs Range, are included with the map folio for the geological, geophysical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada. These were prepared for the Shoal Event of the Vela Uniform Program. (R.J.S.)

3169 THE MEASUREMENT OF THE ARTIFICIAL RADIOACTIVITY OF RAINFALL AND DUST. W. Rentschler and H. Schreiber (Landwirtschaftliche Hochschule, Stuttgart). Atomkernenergie, 7: 325-8(Sept. 1962). (In German)

An automatically operating device for the separate sampling of rainfall and dust in order to measure the fallout radioactivity is described. The first results are reported. The contribution of the dust activity to the entire fallout activity was 30 to 40% in autumn 1961 and 10 to 15% in spring 1962. A fractionation effect for dust and rain samples was established by means of γ spectrometry. (auth)

3170 THE ARTIFICIAL RADIOACTIVITY OF THE GROUND-LEVEL AIR IN STUTTGART-HOHENHEIM AS A RESULT OF THE 1961/62 NUCLEAR EXPLOSIONS. W. Rentschler and P. H. Wieser (Landwirtschaftliche Hochschule, Stuttgart). Atomkernenergie, 7: 328-9(Sept. 1962). (In German)

The daily variations of ground-level air β activity at Stuttgart-Hohenheim from Sept. 1961 to March 1962 are interpreted. The maxima from Sept. 14 to Nov. 16, 1961, may be attached to the particular events of the Russian test series. The average delay between the tests and the increasing of the β activity at Stuttgart-Hohenheim was 13 days. A real periodicity of the maxima of β activity from Nov. 1961 to March 1962 was observed. A repeated circulation round the earth of the radioactive clouds of the 30- and 60-Mt bombs may explain this relation. (auth)

3171 ON THE DIFFUSION OF RADIOGENIC GASES FROM MINERALS. A. N. Murin, S. N. Banasevich, and I. M. Morozova (Leningrad State Univ.). Geokhimiya, No. 10, 874-9(1962). (In Russian)

An approximate method of treating results of experiments on gas removal from solid samples, which reveals the activation energy spectrum of the diffusion process, is proposed. As an example a case of radiogenic argon loss by microcline perthite during its thermal annealing is considered. (auth)

3172 AGE DETERMINATION OF BASIC ROCKS ACCORDING TO THE K/AR-METHOD. E. K. Gerling, Yu. A. Shukolyukov, T. V. Koltsova, I. I. Matveeva, and S. Z. Yakovleva (Lab. of the Geology of Precambrian, Academy of Sciences, Leningrad). Geokhimiya, No. 11, 931-8(1962). (In Russian)

Results of age determinations of 34 samples of basic and ultrabasic rocks of the Transbaikal, Karelia, and Kola peninsula are given. For basic rocks of the Kola peninsula and Karelia age values from 1580×10^6 years to 6500×10^6 years were obtained. It is suggested that the most ancient age figures, reaching 6500×10^6 years, are related to xenoliths of the subcrustal matter of the earth. (auth)

3173 METHODS OF ELUCIDATING THE TRANSPORTATION FORMS OF CHEMICAL ELEMENTS IN GEOCHEMICAL PROCESSES. V. V. Shcherbina. Geokhimiya, No. 11, 945-52(1962). (In Russian)

The paragenetic interrelations of minerals were investigated as criteria for the elucidation of possible transportation forms of chemical elements in geochemical processes. The compounds must possess such physicochemical properties which make their transportation possible in a real geochemical environment (composition of the medium, alkalinity or acidity, oxidation—reduction level, temperature, and pressure). All natural reactions tend to proceed by the most simple way. The transformation forms of chemical elements define their ability for migration, the

types of chemical reaction and the environmental conditions of mineral formation. (auth)

3174 URANIUM AND THORIUM IN IGNEOUS ROCKS OF THE WESTERN TRANSBAIKAL. V. A. Smirnov. Geokhimiya, No. 11, 982-8(1962). (In Russian)

In the history of evolution of the Western Transbaikal mobile zone two accumulation cycles of radioactive elements in intrusives are outlined: the lower-paleozoic and the mesozoic. In each of the cycles occurs first an increase of U- and Th-content and of the Th/U-ratio in rocks of successive magmatic phases, and then a lowering of the whole content of radioactive elements and of the Th/U-ratio. In the last magmatic phases of both cycles in parallel with the saturation of the melt with volatile components noticeably increases the role of mobile uranium. A tendency to primary uranium and thorium accumulation in acid and alkaline magma differentiates is outlined. (auth)

3175 BORON DISTRIBUTION IN RECENT LAKE SEDIMENTS. A. I. Mun and R. E. Zhaimina (Inst. of Chemistry, Academy of Sciences of the Kazakh SSR). Geokhimiya, No. 11, 1000-8(1962). (In Russian)

Silt solutions enriched in boron are related to silts enriched in organic matter. In other cases the liquid phase of lake bottom sediments contains less boron than the corresponding surface waters. The increase of the water-soluble boron in salt-water and fresh-water silts with the increase of organic carbon in them is shown, the dependence being less distinctly expressed for sediments of fresh-water basins. The boron content (absolute and relative) in silt solutions decreases with depth. (auth)

3176 RUBIDIUM-STRONTIUM DATING OF SHALES BY THE TOTAL-ROCK METHOD. W. Compston and R. T. Pidgeon (Australian National Univ., Canberra). J. Geophys. Research, 67: 3493-3502(Aug. 1962).

Measurements of Rb^{87}, Sr^{88}, and Sr^{87}/Sr^{86} are reported for total-rock samples of three shale formations. These data allow calculation of the time of deposition for one formation known to be of Lower Silurian age and of either the deposition or metamorphism for another. The calculation is based on the model that each formation was once uniform in its ratio of Sr^{87}/Sr^{86} and that the observed distribution of Rb/Sr through each formation was established at that time. By considering the sources of error in the measurements, it is believed that a small but definite range in Sr^{87}/Sr^{86} actually occurred, rather than complete uniformity. Nevertheless, excellent agreement is found between the calculated value and the current estimates for the absolute age of Lower Silurian. The data for the third formation indicate that its ratio of Sr^{87}/Sr^{86} was always highly nonuniform. Measurements of Sr^{87}/Sr^{86} for sea water from various localities are also reported. The variation in this ratio is very small, and the absolute values are significantly lower than those calculated for Sr^{87}/Sr^{86} in the shale formations at the times of their deposition. These observations show that the strontium fixed in the shales during deposition was not entirely precipitated from sea water; some must already have been enriched in radiogenic strontium relative to sea water. A small amount of detrital mica or feldspar distributed irregularly through the shales must be responsible for the nonuniformity of their initial ratios of Sr^{87}/Sr^{86}. (auth)

3177 COSMIC-RAY-PRODUCED STABLE ISOTOPES IN IRON METEORITES. Heinz Stauffer and Masatake Honda (Univ. of California, San Diego). J. Geophys. Research, 67: 3503-12(Aug. 1962).

The isotopic composition of vanadium, calcium, and potassium extracted from several iron meteorites was measured. The isotopes V^{50}, Ca^{46}, Ca^{43}, and K^{40} were found to be strongly enriched by cosmic-ray-induced spallation reactions. The concentrations of these isotopes were determined by isotopic dilution techniques. The results are compared with data on cosmogenic Sc^{45} and rare gas isotopes in order to determine the distribution of stable spallation products. The concentration C(A,Z) of a stable spallation product can be given as a function of the total mass loss $\Delta A = 56 - A$ by the equation $C(A,Z) = \gamma(A,Z)k_1(\Delta A)^{-k_2}$ where $\gamma = 1$ for cumulative and $0 < \gamma < 1$ for noncumulative isotopes. This equation is experimentally verified for a wide range of ΔA. The constants k_1 and k_2 were calculated for each meteorite. Especially from the constants k_2 we obtain information concerning the location of the samples inside of the preatmospheric meteorite bodies. Exposure ages were estimated by comparing the concentrations of K^{40} with those of stable isotopes. Comparison with Cl^{36}-Ar^{36} exposure ages indicates an essentially constant cosmic-ray bombardment during the time of exposure. (auth)

3178 SELF-CONSISTENT CALCULATION OF THE RING CURRENT. David B. Beard (Lockheed Missiles and Space Co., Palo Alto, Calif. and Univ. of California, Davis). J. Geophys. Research, 67: 3615-16(Aug. 1962).

The charged particles that created a ring current about the earth move in a magnetic field that differs from the geomagnetic field because of the magnetic disturbance of the ring current itself. It is shown that an approximate self-consistent calculation of the magnetic effects of the ring current is computed in the presence of the ambient field. (W.D.M.)

3179 ON A SELF-CONSISTENT CALCULATION OF THE RING CURRENT FIELD. Syun-Ichi Akasofu (Univ. of Alaska, College). J. Geophys. Research, 67: 3617-18(Aug. 1962).

A rigorous formulation of a self-consistent ring current is discussed. The displacement current is neglected. A self-consistent magnetic field is produced by the ring current when appropriate initial and boundary conditions are taken. A continuous enhancement of the belt will introduce an electric field which causes a drift motion of the particles and deforms the initial distribution of the belt. (W.D.M.)

3180 CORRECTION OF INITIAL PHASE MEASUREMENTS FOR THE SOUTHEAST ALASKA EARTHQUAKE OF JULY 10, 1958, AND FOR CERTAIN NUCLEAR EXPLOSIONS. James N. Brune (Columbia Univ., Palisades, N. Y.). J. Geophys. Research, 67: 3643-4(Aug. 1962).

Phase measurements given previously need to be revised because of an error of π in correcting for the instrumental phase shift. The results from the southeast Alaska earthquake of July 10, 1958, and from high-altitude nuclear explosions are discussed. (W.D.M.)

3181 PLATINUM AND IRIDIUM ABUNDANCES IN METEORITES. Walter Nichiporuk and Harrison Brown (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 9: 245-6(Sept. 15, 1962).

The determination of platinum and iridium in meteorites was carried out to obtain data for a more precise estimation of the abundance peak near mass 195 in the atomic abundance curve. Spectrographic determinations were carried out on twenty-four iron meteorites and five chrondritic stony meteorites. The average abundances are tabulated and compared to previous measurements and calculations. (H.D.R.)

3182 BACKGROUND RADIOACTIVITY IN THE DECORAH FAULT REGION. Philip J. Lorenz, Orville C. Rodenberg, Larry G. Shalde, Alan C. Antes, and William D.

Hess (Upper Iowa Univ., Fayette). Proc. Iowa Acad. Sci., 68: 397-403(1961).

A fault site at Decorah, Iowa, was surveyed for indicative variations in surface radioactivity. A portable ionization chamber revealed significant increases in gamma ray intensity at several locations. At one point the radiation level was 70% greater than the background intensity. Measurements repeated one year later verified this pattern. Radiation contours were plotted over an extensive area in the city of Decorah. This map, with other items of supporting evidence, indicated a possible fault strike of approximately N 55° W. (auth)

3183 RESULTS OF THE DETERMINATION OF NATURAL ATMOSPHERIC RADIOACTIVITY. F. Barreira and J. M. Machado (Laboratório de Fisica da Comissão de Estudos da Energia Nuclear, Lisbon). Rev. Fac. Cien., Univ. Lisboa, 2a Ser. B, 7: 57-75(1959). (In Portuguese)

Atmospheric Rn concentrations were determined almost daily in Lisbon from May 1956 to March 1958. The possible effects of wind direction, precipitation, relative humidity, and dust concentration on the Rn concentrations were studied. Continental winds were seen to be higher in Rn content than oceanic winds. Winds which traversed regions where U ores were located showed the highest Rn content. (R.J.S.)

3184 NIOBIAN ESCHYNITE. Pei-shan Chang (Academia Sinica, Peking). Sci. Sinica (Peking), 11: 969-76(July 1962). (In English)

The niobian eschynite discovered in North China contains 41.13% Nb_2O_5 and 12.13% TiO_2. The essential compositions are (in per cent): Ce_2O_3, 11.56; $[Ce]_2O_3$, 19.61; Nb_2O_5, 4.13; Fe_2O_3, 6.78; CaC, 3.54; ThO_2, 2.15; total 99.77. Crystals are orthorhombic tablets with black, brown, and adamantine luster with index of refraction $n > 2.00$, $2V(-)$ about 80°, and distinct dispersion $\nu > \rho$. The brittle non-magnetic, and radioactive crystal specific gravity was 5.056. It has good optical properties. After six hours at 950°C, it shows orthorhombic symmetry, space group $D_{2h}^{16} = P_{bnm}$, $a_0 = 5.32 \pm 0.01$, $b_0 = 11.09 \pm 0.02$, $c_0 = 7.52 \pm 0.01$ Å. The strongest lines of the x-ray powder pattern are 3.01 Å, 2.912 Å, and 1.55 Å. From the nomenclature of this mineral series, eschynite $CeNbTiO_6$ and priorite $YNbTiO_6$ would represent the two end members of a binary system. (auth)

3185 GUGIAITE, $Ca_2BeSi_2O_7$, A NEW BERYLLIUM MINERAL AND ITS RELATION TO THE MELILITE GROUP. Chi-jui Peng, Rung-lung Tsao, and Zu-rung Zou (Academia Sinica, Peking). Sci. Sinica (Peking), 11: 977-88(July 1962). (In English)

Gugiaite was found in skarn rocks with melanite, orthoclase, idocrase, aegirine, sphene, apatite, and prehnite. It occurs as clear tetragonal tablets, mostly 2 to 3 mm across and 0.3 to 0.5 mm thick in cavities and disseminated in melanite. The carbonate rocks are of Cambrian age, and are intruded by an alkaline syenite belonging to an alkaline igneous complex of the area. (auth)

3186 NUCLEAR RADIATION IN GEOPHYSICS. H. Israël and A. Krebs, Eds. New York, Academic Press Inc., Publishers, 1962. 443p. $18.00.

Twelve papers of a review nature are presented on radioactivity in geophysics. They treat diverse topics such as tracers, radioactivity distribution, age determination, atmospheric circulation, fallout, biological effects, cosmic rays, and radioactivity measurement. Separate abstracts were prepared for all the papers. (D.L.C.)

3187 RADIOACTIVITY OF THE LITHOSPHERE. John A. S. Adams. p.1-17 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In English)

The sampling of the lithosphere for radioactivity measurements is reviewed, and it is shown that large volumes of the lithosphere do not vary in radioactivity by more than a factor of two or three. The concentrations are approximately 11 to 15 ppm Th, 3 to 4 ppm U, and 3 ppm K^{40}. The quality of the abundance data is reviewed, and it is shown that the four major radioactive nuclei may be divided into two groups on the basis of close chemical similarity, K-Rb and Th-U. Heat effects are considered briefly. The distribution of radioactive nuclei is considered on both macro and micro scales. Radiation damage in rocks is present as pleochroic haloes, discoloration, thermoluminescence, etc. Possible effects of radiation from the lithosphere and extra-terrestrial sources on ancient life, as evidenced by the fossil record, are considered. The effects of radioactive decay on stable isotope abundances and on geologic and geochemical processes are discussed. (D.L.C.)

3188 RADIOACTIVITY IN OCEANOGRAPHY. F. F. Koczy and J. N. Rosholt. p.18-46 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In English)

A rapid development of knowledge and use of radioisotopes in oceanography is described. The occurrence of radioisotopes in the ocean is discussed in detail for the following types of radioisotopes: primordial, cosmic-ray-produced, and artificial (fallout and waste). The use of tracers in studying the oceanic interfaces with atmosphere, continents, and sediments and the oceaning mixing is discussed, and future applications are considered. Tables of concentrations in ocean water are given for a large number of radioisotopes. (D.L.C.)

3189 RADIOACTIVITY IN HYDROLOGY. Erik Eriksson. p.47-60 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In English)

The concentration and behavior of radioisotopes in natural waters are discussed for radioisotopes from the U and Th series in rocks, tritium, C^{14}, and artificial radioisotopes. Hydrological problems and methods of solving them with tracers are discussed. (D.L.C.)

3190 RADIOACTIVE METHODS OF AGE DETERMINATION. p.61-75 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In English)

For rock age determination on the basis of radioactivity, four methods are available: potassium-argon method, rubidium-strontium method, uranium-lead method, and carbon-14 method. A survey is given of the basis, applications, and limits of each method. The chief results are described briefly. (D.L.C.)

3191 NATURAL AND ARTIFICIAL RADIOACTIVITY IN THE ATMOSPHERE. H. Israël. p.76-96 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In German)

The atmosphere's natural radioactivity arises from a circulation process, in which the inert gas from the three decay series diffuses from the soil into the atmosphere and its transport is controlled by the atmospheric "austausch." The natural radioactivity is chiefly radon, thoron, and their decay products. A short survey is also presented on the artificial radioactivity of the atmosphere, and data on height distribution and time variation of fission products are given. (D.L.C.)

3192 PRODUCTION OF RADIOACTIVE NUCLEI BY COSMIC RAYS. O. Haxel and G. Schumann. p.97-135 of

"Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In German)

Most of the present knowledge of radioisotopes produced by cosmic radiation is centered on the atmosphere and meteorites. The most efficient processes producing radioactivity are spallation and thermal neutron capture of N_2 giving C^{14}. The mean intensity of cosmic radiation probably was constant within a factor of 2 for millions of years. A steady-state model gives a good approximation for the C^{14} contents in the biosphere and oceans. Other radioisotopes detected were Be^7, Be^{10}, Na^{22}, Si^{32}, P^{32}, P^{33}, S^{35}, Cl^{36}, and Cl^{39}. The natural tritium production is not known very well. Production of radioisotopes in the lithosphere was detected only at high altitudes. Meteorites are discussed. (D.L.C.)

3193 TRANSFER AND CIRCULATION OF RADIOACTIVITY IN THE ATMOSPHERE. Bert Bolin. p.136-68 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In English)

The complexities of atmospheric motions are described. In considering radioactive tracers for atmospheric studies, different scales of motion in the atmosphere must be used: (1) small-scale atmospheric transfer at distances less than 10 km, particularly the surface boundary layer; (2) intermediate-scale transfer on a scale from 10 to 1000 km; and (3) global transfer on scales larger than 1000 km. The theory of diffusion is described briefly, and then each of the scales is discussed. (D.L.C.)

3194 RADIOACTIVE AEROSOLS. Christian E. Junge. p.169-201 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In German)

Natural aerosols act as carriers for the radon and thoron decay products. The main features of these aerosols are discussed, and it is shown that Smoluchowsky's theory is a good approximation of the process of attachment of the decay products to the aerosol particles. Isotopes induced by cosmic radiation are discussed. The structure of fallout particles from atomic tests depends on the type of test, and medium- and long-range fallout is discussed. The sorption of radioactive gases on reactor aerosols is discussed, and it is concluded that iodine sorption becomes important when the iodine concentration is $\sim 10^{-3}$ of that of the aerosol. (D.L.C.)

3195 RADIOACTIVE PRECIPITATIONS AND FALLOUT. L. Facy. p.202-40 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In English)

A review is presented on the physics of fallout. Fallout is of three types: local, tropospheric, and stratospheric. Both dry and wet fallout are discussed. In the case of dry fallout, the settling velocity of small particles, diffusion, turbulence, coagulation, etc., are discussed. For wet fallout, condensation of small particles on cloud and rain droplets, rain-out, wash-out, snow-out, etc., are discussed. Finally, turbulent mixing and direct ground capture of air activity are discussed. (D.L.C.)

3196 BIOLOGICAL ASPECTS. A. T. Krebs and N. G. Stewart. p.241-94 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In English)

Nuclear radiations in geophysics, with a few exceptions, present typical low dose-long time irradiation phenomena. Natural radiation sources, both external and internal, are described. The difficulties involved in biological evaluation of natural radiation sources are discussed, and estimated somatic and genetic effects are described. Man-made environmental contamination is next considered, e.g., fallout and atomic wastes. Waste disposal is considered, and the Windscale accident is discussed. Maximum permissible doses and reactor siting are also discussed. (D.L.C.)

3197 MEASUREMENT METHODS. G. Schumann. p.295-342 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In German)

Problems of low-level counting in geophysics are discussed. Ways of increasing the counter efficiency and reducing the background are considered. Thick sources present particular problems for β counting because of backscattering, self-absorption, and self-scattering. Sampling methods are discussed, and ways of measuring the radioactivity of different kinds of samples are specified. Radiochemical methods for separating β emitters are reviewed briefly. It is concluded that α and γ spectroscopy, but not β spectroscopy, are applicable to geophysical problems. (D.L.C.)

3198 COSMIC RAYS IN GEOPHYSICS. A. Ehmert. p.343-85 of "Nuclear Radiation in Geophysics." New York, Academic Press Inc., Publishers, 1962. (In German)

A survey is given on the nature, energy distribution, and variations of primary galactic cosmic rays. The secondary components are reviewed, and the modulation of the primary components is discussed in detail. It is shown that electric field modulation gives a good description of the measured variations. Modulation by sun activity is compared with earth magnetic disturbances of the ring current field type; this comparison is used to estimate the total magnetic field component originating outside the earth. Anisotropic modulation and solar cosmic rays are discussed, and it is shown that solar cosmic rays do not show the modulation observed for galactic cosmic rays. (D.L.C.)

3199 COMPARISON LOGGING OF GEOLOGIC FORMATION CONSTITUENTS. Jack Green (to California Research Corp.). U. S. Patent 3,061,725. Oct. 30, 1962.

Methods of and apparatus for radioactivity well logging are described. The particular application described is for the determination of the presence of petroleum crude and carbonate formations in any earth formation penetrated by a well bore. (R.J.S.)

3200 WELL LOGGING APPARATUS. Wayne R. Arnold (to Schlumberger Well Surveying Corp.). U. S. Patent 3,061,728. Oct. 30, 1962.

Methods and apparatus are described for well logging. An improved neutron generator especially adapted to traverse the narrow confines of a well or bore hole is employed. (R.J.S.)

HEALTH AND SAFETY

Refer also to abstracts 2746, 2752, 3663, 3664, 3688, 3727, 3762, and 3798.

3201 (AD-275905) SUMMARY OF RADIOACTIVE FALL-OUT MEASUREMENTS. Joh. Blok, J. F. Bleichrodt, and R. H. Dekker (Netherlands. Rijksverdedigingsorganisatie, TNO. Medisch Biologisch Laboratorium, Rijswijk). May 1961. 59p. (MBL/1961/9)

Measurements were made of artificial radioactivity in air samples collected from April through July 1959 at 4 locations in the Netherlands. Data are tabulated. (C.H.)

3202 (BNL-5974) USE OF A PORTABLE WHOLE-BODY COUNTER TO MEASURE INTERNAL CONTAMINATION IN A FALLOUT-EXPOSED POPULATION. S. H. Cohn, R. A. Conard, E. A. Gusmano, and J. S. Robertson (Brookhaven National Lab., Upton, N. Y.). 1961. 25p.

The Marshallese people of Rongelap Atoll, who were accidentally exposed to fallout in 1954, were the subject of a large scale survey for evaluating radionuclide body burdens in 1961. Experience is described in the use of a portable whole-body gamma counter, with details on measurements made, methods used, and automatic data-handling techniques developed for recording and analyzing the survey data. (R.J.S.)

3203 (BNL-6001) A PRELIMINARY REPORT ON HEALTH PHYSICS PROBLEMS AT THE BROOKHAVEN ALTERNATING GRADIENT SYNCHROTRON (AGS). F. P. Cowan (Brookhaven National Lab., Upton, N. Y.). Mar. 5, 1962. Contract [AT(30-2)-Gen-16]. 4p.

A preliminary summary of health physics problems is presented. Personnel monitoring is effected by means of Eastman NTA nuclear track films. A major hazard is posed by beams brought out through the shielding. Comments are made concerning dosimetry problems. (R.J.S.)

3204 (CEA-2164) LES PROBLEMES DE RADIOPROTECTION POSES PAR LES ISOTOPES DE L'IODE DANS LES INSTALLATIONS DE TRAITEMENT CHIMIQUE DES COMBUSTIBLES. (Radio-Protection Problems Presented by Iodine Isotopes in Nuclear Fuel Chemical Treatment Plants). H. Bouzigues, J. Scheidhauer, and L. Messainguiral (France. Commissariat a l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1962. 19p.

The origin of I^{131} and the conditions in which it is liberated from atomic energy industrial installations are reviewed. The question of the risks associated with the presence of this radioelement in the atmosphere is discussed. A method is proposed for the trapping and rapid measurement of the iodine in the vapor form, applicable to radioprotection. (auth)

3205 (DP-783) AUTOMATIC PROCESSING SYSTEM FOR FILM BADGES. Joseph W. Adams (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Sept. 1962. Contract AT(07-2)-1. 23p.

A semiautomatic film badge system was developed to process dosimeter film faster and more reliably than the previously used manual method. The films are automatically loaded and unloaded from the badges and marked with identifying numbers, manually developed, and automatically read. The resultant information is punched into IBM cards. (auth)

3206 (HMI-B-23) RADIOAKTIVITÄT IN DER UMGEBUNG DES BER IM JAHRE 1961. (Radioactivity in the Surrounding of the BER During 1961). W. Jacobi (Hahn-Meitner-Institut für Kernforschung, Berlin). May 1962. 19p. (BC-21)

The results of measurements of fission product and natural radioactivity in air, rain, surface and ground water and of the intensity of the environmental β- and γ-radiation in Berlin-Wannsee during 1961 are summarized. Following the nuclear weapon tests in the USSR, beginning in September 1961, the fission product activity in air and rain rose for more than an order of magnitude. On account to the fallout of fission products the environmental γ-radiation during October to December 1961 was about 30% higher than the natural background. The operation of the reactor and radiochemical laboratories caused no detectable increase of activity or radiation in the surrounding. (auth)

3207 (HW-SA-2785) SOME NOTES ON PRACTICAL NEUTRON DOSIMETRY. C. C. Gamertsfelder, P. E. Bramson, G. W. R. Endres, and R. H. Wilson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Oct. 11, 1962]. Contract AT(45-1)-1350. 20p.

Procedures are discussed that have been developed for the routine monitoring of neutron radiation doses to operating personnel as well as providing for the measurement of the larger doses that can result from inadvertent nuclear excursions. Topics discussed include the development of a moderated foil criticality dosimeter, results of studies of the modified resistance characteristics of silicon diodes exposed to neutrons, and a procedure for quickly identifying personnel exposed to a criticality incident by observation of the counting rate of an ordinary portable GM counter held at the abdomen while the possibly exposed person bends over the counter. (C.H.)

3208 (NAA-SR-7650) ENVIRONMENTAL MONITORING SEMIANNUAL REPORT, JANUARY 1, 1962 TO JUNE 30, 1962. J. D. Moore, W. L. Fisher, and P. A. Rowe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1962. Contract [AT(11-1)Gen-8]. 29p.

Soil, vegetation, air, and water are routinely sampled up to a distance of 10 miles from Atomics International property. Data gathered during the period January 1, 1962 to June 30, 1962 have been summarized and compared with previous data. During this period, a general increase was observed in environmental radioactivity levels. This increase is attributed to nuclear weapons tests and not to Atomics International operations. The effect of nuclear weapons tests is readily shown in the air sample data. A general description of the environmental monitoring program and procedures is included. (auth)

3209 (NP-12186) AN ASSESSMENT OF THE POSSIBLE HEALTH HAZARDS OF URANIUM–STEEL ALLOYS. A. H. Booth and M. Pollard (Canada. Dept. of National Health and Welfare. Radiation Protection Div., Ottawa). May 1961. 33p. (RPD-12)

The radiations from uranium steel alloys are described and a theoretical calculation is presented of γ, β, and α radiation fluxes, based on published values of the disintegration rates of the isotopes concerned and on their β and γ energy spectra. The possible health hazards are considered that would result from the use of steel containing a few tenths of one percent U for the fabrication of complicated shapes such as car bodies, crank shafts, and in high-

pressure piping and from the use of steel containing from 10 to 15% U for tool steels. Data are tabulated on dose calculations and comparison is made with data on maximum permissible doses as recommended by the I.C.R.P. In each case the estimated γ dose from U steel applications was well below the maximum permitted for all radiation sources. (C.H.)

3210 (NP-12227) RADIATION SAFETY PROCEDURES AND REGULATIONS. Askari Imam Hashmi (Pakistan. Atomic Energy Centre, Lahore). Oct. 1961. 33p. (AECL/HP/1)

Radiation safety procedures and regulations of the Pakistan Atomic Energy Commission are outlined. (C.H.)

3211 (NYO-8102) A STUDY OF THE MOVEMENT AND DIFFUSION OF AN INTRODUCED CONTAMINANT IN NEW YORK HARBOR WATERS. Technical Report No. 31. D. W. Pritchard, Akira Okubo, and Emanuel Mehr (Johns Hopkins Univ., Baltimore. Chespeake Bay Inst.). Oct. 1962. Contract AT(30-1)-1477. 95p.

Direct observations of the movement and dispersion of an introduced radioactive contaminant were made in a hydraulic model of the New York Harbor estuarine system. A map of the prototype area is included. The purpose of the study was the prediction of the spread of any radioactive material that might be introduced into these waters, with particular reference to nuclear-powered shipping. Results are compared with results obtained from a mathematical model. Topics discussed include processes of advection and diffusion that lead to the movement and spread of any introduced water-borne material in a tidal waterway such as the Hudson-East River complex, various theoretical treatments of turbulent diffusion, numerical solutions of the two-dimensional transient advection-diffusion equation using an IBM 704 or 7090 computer, and differences between the results obtained from the mathematical model and the hydraulic model. It is anticipated that the basic results of this study can be applied, with suitable modification, to other harbors that might serve as ports of call for nuclear-powered vessels. (C.H.)

3212 (TID-3525(Rev. 4)) REACTOR SAFETY. A Literature Search. Richard J. Smith, comp. (Division of Technical Information Extension, AEC). Mar. 1962. 104p.

A total of 1555 references to unclassified reports and published literature is presented on reactor systems, materials, and operation designed to provide maximum safety for the reactor, reactor personnel, and environs. Information is included concerning incidents and conditions of operation considered hazardous. Author and report number indexes are provided. (auth)

3213 (TID-7635) REPORT OF WORKING MEETING ON SHIPPING CONTAINER TESTING PROGRAMS AT THE JOHNS HOPKINS UNIVERSITY, MAY 2-3, 1962. James M. Morgan, Jr., Arnold B. Joseph, John D. Stevenson, and Donald K. Jamison, eds. (Johns Hopkins Univ., Baltimore). Aug. 1962. Contract AT(30-1)-1477. 154p.

Separate abstracts were prepared on 14 papers presented at this meeting. (C.H.)

3214 (TID-7635(p.10-21)) AN OPERATIONS RESEARCH STUDY OF THE POTENTIAL ACCIDENT EXPERIENCE AND TOTAL COST OF TRUCK SHIPMENTS OF HIGHLY RADIOACTIVE MATERIALS. F. F. Leimkuhler (Purdue Univ., Lafayette, Ind.).

The risks and economics involved in the transportation of highly radioactive materials by truck were studied in at attempt to identify the significant factors and relationships that apply and to develop acceptable methods of optimizing transportation safety and transportation costs. A schematic diagram is presented of a model system for the transportation of radioactive materials. The model is evaluated for accident characteristics, vehicle and container design, operating costs, operational controls, and decision processes. (C.H.)

3215 (TID-7635(p.21-8)) REVIEW OF CONSEQUENCES AND COST OF ACCIDENTS IN THE TRANSPORTATION OF HIGHLY RADIOACTIVE MATERIALS. James M. Morgan, Jr. (Virginia Military Inst., Lexington, Va.).

Evaluations were made of the possible consequences of accidental releases of high level radioactive materials during shipment. Truck accident situations are visualized, unit costs for remedial operations cited, and losses established. The following items, pertinent to cost analysis, are reviewed: transportation practices, and shipping containers; ability of large metropolitan areas to handle accident situations; characteristics of the high level wastes; fate of radioactive materials in the environment; removal of radioactive nuclides by water treatment facilities; and decontamination procedures. (auth)

3216 (TID-7635(p.28-32)) ORNL CASK TESTING PROGRAM. K. W. Haff (Oak Ridge National Lab., Tenn.).

Results are reported from non-destructive tests and fire tests on ORNL casks designed for use in shipping radioactive materials. (C.H.)

3217 (TID-7635(p.32-45)) FIRE TESTING OF SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS. Leonard Horn (Underwriters' Labs., Inc., Chicago).

Procedures used in fire exposure tests are reviewed. Results are reported from fire tests on two types of ORNL shipping containers and a prototype Co^{60} teletherapy head. The teletherapy head and small shipping container showed no appreciable damage. A larger type 55 unit exploded during fire testing. Design modifications are suggested for this container. (C.H.)

3218 (TID-7635(p.59-77)) HEAT TRANSFER STUDY OF COBALT-60 SHIPPING CONTAINER. L. B. Adler (Brookhaven National Lab., Upton, N. Y.).

Results are reported for a series of heat removal experiments made on lead shipping containers used for transporting tens of kilocuries of Co^{60}. Measurements were made of internal temperatures in a cask loaded with 83-kc amounts of Co^{60}. Heat transfer mechanisms are discussed. (C.H.)

3219 (TID-7635(p.78-80)) BROOKHAVEN CONTAINER TESTING PROGRAM. F. A. Dugan (Brookhaven National Lab., Upton, N. Y.).

Results are reported from laboratory drop tests, measurements of heat generation from loaded casks, and examination of loaded casks involved in accidents during the transportation of radioactive materials for structural integrity. The need for improvement in tie-down attachments for casks is discussed. (C.H.)

3220 (TID-7635(p.81-2)) UNIQUE LICENSING PROBLEMS. Christian Beck (Atomic Energy Commission, Washington, D. C.).

Results are reported from a review of shipping casks for compliance with the proposed AEC Part 72 Regulations governing the shipment of radioactive materials. Topics discussed include the contribution of the lead shield in resisting impact on the cask, the buckling of structural members under impact, vibration effects on casks during transport, protection from mechanical damage of external functional parts of the cask, and the effects of rough treat-

ment and long usage on structural integrity of shipping containers. (C.H.)

3221 (TID-7635(p.83-96)) CASK TEST PROGRAM AT ORNL. L. B. Shappert (Oak Ridge National Lab., Tenn.).

Data are tabulated from strain measurements and cavity deflection for 8 model shipping casks for radioactive materials subjected to drop tests at heights varying from 6 in. to 16 ft. Instrumentation used in the tests is described. (C.H.)

3222 (TID-7635(p.97-111)) REVIEW OF RESEARCH ON STRUCTURAL INTEGRITY OF SHIPPING CONTAINERS FOR RADIOACTIVE MATERIALS. H. G. Clarke (Franklin Inst., Philadelphia).

Results are reported from studies on a variety of problems relating to the strength of shipping containers for radioactive materials. The object of our work is to define a rational basis for assessing the structural integrity of these containers during both normal transport operations and accidents. This has required that we consider not only the container structure itself but also the vehicle, the rigging, and the general shipping environment. Our interest has been primarily in the larger containers used to ship high level wastes and irradiated fuel elements by either rail or highway transport. The final results of the investigation are expected to be criteria and procedures for designing containers that have a known degree of structural safety in shipment and are also not too costly to construct. (auth)

3223 (TID-7635(p.112-15)) SHIPPING PROBLEMS AND TESTING AT SANDIA CORPORATION. R. G. Clay (Sandia Corp., Albuquerque, N. Mex.). (TID-16551)

The design of containers and handling equipment for use during the transport of materials containing both high explosives and nuclear materials is discussed. Special features and testing procedures are described for a railway car designed to reduce the effects of accidents. Data are included from analyses of railroad, truck, and aircraft accidents that might result in the explosion of a high explosive device. Economic and weight factors affecting the design of shipping containers are discussed. (C.H.)

3224 (TID-7635(p.116-21)) REVIEW OF BRITISH TESTING PROGRAM. R. F. Barker (Atomic Energy Commission, Washington, D. C.).

The British program of testing shipping containers for radioactive materials is reviewed. Design features of three types of packaging are summarized. Results are included from a survey of the environment that may be anticipated for various modes of transport. Methods used in the testing of shielded containers are discussed. (C.H.)

3225 (TID-7635(p.122-4)) DISCUSSION OF AEC TECHNICAL TRANSPORT PROBLEMS. L. R. Rogers (Atomic Energy Commission, Washington, D. C.).

Present and proposed regulatory standards for the transport of radioactive materials are discussed. Emphasis is placed on proposed standards to be used by all federal agencies to amend and revise existing transport regulations, the Part 71 standard dealing with criticality safety in shipping fissile material, and the proposed Part 72 standard for the regulation of shipping of irradiated fuel elements. (C.H.)

3226 (TID-7635(p.125-8)) DISCUSSION OF AEC TECHNICAL TRANSPORT PROBLEMS. D. E. Patterson (Atomic Energy Commission, Washington, D. C.).

The effects of variables such as container design, tiedowns, traffic control, and weather on safety in the transport of radioactive materials are considered. Technical transport problems of the AEC are reviewed. (C.H.)

3227 (TID-7635(p.128-33)) DISCUSSION OF AEC TECHNICAL TRANSPORT PROBLEMS. J. W. Hitch (Atomic Energy Commission, Washington, D. C.).

Problems involved in the shipment of radioisotopes in both large and small quantities, γ sources, and other radioactive materials are reviewed. The importance of container design is stressed. (C.H.)

3228 (TID-16764) A SUMMARY OF INCIDENTS INVOLVING USAEC SHIPMENTS OF RADIOACTIVE MATERIAL, 1957–1961. D. E. Patterson and V. P. DeFatta (Division of Operational Safety. Industrial Safety and Fire Protection Branch, AEC). 80p.

Data are summarized on incidents that have been sustained by the AEC in the transport of radioactive materials from 1957 through 1961. In the period covered by this report there were 47 incidents reported. Twenty-nine did not result in the release of radioactive materials. Of the remaining 18 cases there was none that involved any serious radiological consequences or involved costly cleanup. Six of the incidents involved onsite movements of materials. The incidents are classified in accordance with the type of radiation release that occurred, mode of transport, and type of incident. Photographs are included for a number of the incidents. (C.H.)

3229 (TID-17025) BASIC RADIOLOGICAL SAFETY TRAINING MANUAL. (Reynolds Electrical and Engineering Co., Inc. Radiological Safety Div., Mercury, Nev.). Revision of January 1962. Contract [AT(29-1)-162]. 115p.

This manual was developed for use in training radiological safety monitors. The fundamentals of physics, mathematics, and principles of radiation and radiation protection are reviewed. Techniques for detecting and measuring radioactivity are described. The control of radiological areas, the fundamentals of personnel dosimetry, concepts of and established values for permissible exposure levels, and techniques for decontamination are discussed. Laboratory procedures are outlined. (C.H.)

3230 (TRG-Inf-Ser-239) BIBLIOGRAPHY ON TRANSPORTATION OF RADIOACTIVE MATERIALS. N. Wright, comp. (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). Sept. 6, 1962. 24p.

A selection of 192 references is presented covering all aspects of the transportation of radioactive materials. References are included to official regulations of many countries and the design of transport containers. (C.H.)

3231 (UCRL-6691) COLLECTION EFFICIENCY OF WHATMAN 41 FILTER PAPER FOR SUBMICRON AEROSOLS. C. L. Lindeken, R. L. Morgin, and K. F. Petrock (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 9, 1962. Contract W-7405-eng-48. 12p.

The collection efficiency of Whatman 41 filter paper has been determined using submicron test aerosols of monodispersed polystyrene latex. Measurements were made over a velocity range of 12 to 195 fpm, using aerosols with diameters of 0.088, 0.188, 0.264, 0.365, and 0.557 μ. For sizes less than 0.557 μ, well-developed efficiency minima occur in the velocity range of 20 to 30 fpm. In no case was the efficiency found to be below 70%. At 195 fpm, the efficiency was essentially size-independent. (auth)

3232 (UCRL-7035) HAZARDS CONTROL QUARTERLY REPORT NO. 9, APRIL–JUNE 1962. (California. Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 47p.

Work was started on the development of a thermoluminescent radiation dosimeter for use as a personnel monitor. An estimate was made of the effectiveness of an air intake system in capturing falling radioactive particles and its relation to the radiation dose rate in a fall-out shelter. Test concentrations of CO in air varying from 0 to 300 ppm were prepared using a portable gas blending unit. Equipment is described for use in the calibration of alnor velometers and other air flow measuring instruments. An evaluation was made of thermoswitches set to energize an alarm at glove box temperatures of 140°F as fire detectors. A portable tester is described for use in the detection of pin-hole leaks in glove box gloves. A system is described for the routine cleaning and refurbishment of respiratory masks. Two relatively inexpensive flooring materials were found to be satisfactory for minimizing the detonation-by-dropping hazard in high-explosive areas. Corrugated rubber matting and heavy duty linoleum were both found satisfactory although both were found to have disadvantages in either the safety or service categories. A survey was made of desirable properties in resilient flooring coverings. Three epoxy-type coatings were tested for resistance to water, caustic solutions, solvents, and oxidizing acids. An automatic data processing system was developed for recording fire extinguisher maintenance. (C.H.)

3233 (USNRDL-TR-570) RADIOLOGICAL RECOVERY OF LAND TARGET COMPONENTS — COMPLEX I AND COMPLEX II. W. L. Owen and J. D. Sartor (Naval Radiological Defense Lab., San Francisco). May 25, 1962. 252p.

Facilities escaping physical damage from a nuclear attack still may have to cope with hazardous amounts of fallout material. The survival of personnel and the resumption of vital missions could depend upon the timely removal of the fallout deposits. The safe performance of such a removal effort is possible only if a detailed radiological recovery plan exists before attack. Two closely similar experiments were conducted on the operational recovery of an artificially contaminated land target complex. In each case a suitable recovery plan was formulated and then executed. The results showed that, within prescribed dose limits, pre-attack planning of a radiological recovery operation is not only feasible but strongly recommended. (auth)

3234 (USNRDL-TR-585) A METHOD FOR DETERMINING MISSION RE-ENTRY TIMES FOR FALLOUT-CONTAMINATED INDUSTRIAL COMPLEXES. H. Lee (Naval Radiological Defense Lab., San Francisco). Mar. 9, 1962. 28p.

In the event of a nuclear war, knowledge of the time of availability, after contamination by fallout, for re-entry and use of certain resources is important in planning and preparing for the nation's recovery. This study is limited to the estimation of the availability time for industrial complexes that are not physically damaged by the attack or by emergency shut-down, but are inaccessible because of radiological contamination by fallout. A method of calculation proposed to be suitable for all industrial complexes was applied to five petroleum refineries. The findings were that the dose to decontamination personnel is the primary factor limiting re-entry and use. For the standard intensity range of 100 to 30,000 r/hr and dose limits of 30 r/24 hr, 230 r/2 wk and 1,000 r/yr, the mission re-entry time for the refineries studied ranged from 1 to 35 days. (auth)

3235 (VDIT-43) TRANSPORT REGULATIONS FOR RADIOACTIVE MATERIALS IN THE USA, GERMANY, FRANCE, UK, RUSSIA ETC. WITH ENCLOSED BIBLIOGRAPHY OF RADIOACTIVE SHIPPING CONTAINERS. A Literature and Official Text Review. E. Bock (Aktiebolaget Atomenergi, Stockholm). Oct. 1961. 85p.

Regulations covering the transport of radioactive materials in the U. S. and U. K. are presented in detail. Proposed changes are discussed. A list is included of 19 handbooks and publications dealing with the shipment of radioactive materials in Germany, France, and Russia, and regulations of the International Atomic Energy Agency. (C.H.)

3236 (VDIT-64) CRITICALITY STUDIES AND SAFETY CONSIDERATIONS, IN PARTICULAR AS APPLICABLE TO PROCESSING PLANTS FOR FISSIONABLE MATERIALS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Sept. 1962. 27p.

Seventy-eight abstracts of recent pertinent publications are included. (C.H.)

3237 (Y-1405) DOSIMETRY BADGE ORIENTATION EXPERIMENT. J. W. Redmond (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Oct. 3, 1962. Contract W-7405-eng-26. 25p.

Dosimetry experiments were conducted to evaluate the orientation capabilities of neutron-activated materials when located around the necks of radiation-equivalent manikins exposed to nuclear excursions from uranium metal and solution sources. Neckpieces were made containing gold, sulfur, or copper. Orientation within forty-five degrees was determinable with either gold or sulfur neckpieces at neutron doses above twenty-five rads. The copper did not provide as sensitive a direction measurement, probably due to backscatter of neutrons from the body. Dosimeters of this type provide a good measure of orientation, may be conveniently worn by all personnel, and provide a consistent attachment location for the personal dosimeter badges that facilitate both dosimetry and security. (auth)

3238 (UCRL-Trans-840(L)) FIRE PROTECTION IN ATOMIC ENERGY RESEARCH INSTALLATIONS. Joern Braun. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from VFDB (Ver. Förder. Deut. Brandschutzes) Z., 11: 9-12(1962). 11p.

Special problems involved in the control of fires in reactor buildings and auxiliary installations are discussed. It is pointed out that personnel of fire departments must know the functions of the various atomic energy research installations. The fundamental principles of nuclear physics that are applicable in training firemen are outlined. (C.H.)

3239 PROTECTION IN THE USE OF DIAGNOSTIC RADIATION. R. C. Burr (Kingston Clinic, Kingston, Ont.). Can. Med. Assoc. J., 86: 527-31(Mar. 24, 1962).

Methods for reducing radiation exposure to a minimum during diagnostic procedures are considered. It is the duty of the physician to decide whether it is of greater value to the patient to have a diagnostic x ray taken than to run the slight risk of radiation damage. It is his duty to reduce the dose of radiation to the lowest limit consistent with good diagnosis, and he must always give special care to protect the gonads and the fetus in utero. The 1st 3 months, especially the 1st month, of the life of the fetus is the time of greatest sensitivity. It would appear that the safest time for using radiation for women in the child-bearing age is in the first 10 days after the beginning of the menstrual period. It is recommended that for fluoroscopy the x-ray tube, the aperture, and the fluorescent screen be so permanently arranged that a useful beam of radiation cannot fall outside the screen. The fluorescent screen should have a protective

glass sheet with lead equivalent of 1.5 mm Al for 100 kmp and a highly fluorescent screen should be used. A timing device, which is cumulative, and an x-ray switch at the fluoroscopic position are essential. Improvements in technique, such as the use of faster screens, faster film and high voltage, will reduce the patient-dose and decrease scattered radiation and stray radiation. In x rays of the pelvis, where the gonads may be exposed, it is well to use high-voltage techniques and to increase the focal-skin distance and limit the use of stationary and mobile grids. Efficient coning will limit the beam and will limit scattering. If possible, of course, the gonads should be excluded from the exposure. A survey made on 81 x-ray machines in various locations throughout Canada showed that 6 x-ray tubes, used over the table, had no added filter and with fluoroscopic tubes 7 of 39 had no added filter. Great variation was found in the output of these machines. (H.H.D.)

3240 EXPERIENCES WITH FILM DOSIMETRY IN RADIATION SAFETY: REPORT ON MEASUREMENT DATA IN THE BERLIN DISTRICT IN THE YEARS 1959 AND 1960. H. Oeser, P. Koeppe, and K. Rach (Strahleninstitut, Freie Universität Berlin). Deut. Med. Wochschr., 87: 181-5 (Jan. 26, 1962).

A statistical survey is made of results of film-badge readings for occupationally exposed persons. The results are analyzed in terms of dosage received by workers exposed during roentgenography and use of radioisotopes, age, sex, and other factors. (H.H.D.)

3241 THE PATTERNS OF FALL-OUT. Philip Goldsmith. Discovery, 23: No. 3, 36-42(Mar. 1962).

When a nuclear weapon explodes, its debris may be scattered in three distinct ways. Recent work on tracing this fall-out pattern has led to a new model of the earth's air circulation, from which the fall-out effects of the recent Soviet test series are predicted. (auth)

3242 RECEIVERS FOR THE NATIONAL EMERGENCY ALARM REPEATER SYSTEM. F. H. Inderwiesen (Midwest Research Inst., Kansas City, Mo.). Elec. Eng. (Trans. Am. Inst. Elec. Engrs.), 80: 670-5(Sept. 1961).

The NEAR system, a recently developed means for rapidly alerting the population in case of emergency, operates by an alarm signal transmitted through the power lines. Operational requirements of the system and technical features of the receiver are discussed. (auth)

3243 TISSUE EQUIVALENT OF FAST NEUTRON DOSIMETERS. M. R. Yudin and O. A. Filippov. Izmeritel. Tekh., No. 4, 37-42(1961). (In Russian)

Descriptions are given of the design and performance of a tissue equivalent fast neutron dosimeter capable of measuring tissue doses from 0.5 up to several hundreds of permissible tissue doses, in μr/sec, with an order of error of 7 to 12%. (R.V.J.)

3244 ALTITUDE DISTRIBUTION OF FALLOUT CONTAINED IN RAIN AND SNOW. K. Itagaki (Hokkaido Univ., Sapporo) and S. Koenuma. J. Geophys. Research, 67: 3927-33(Sept. 1962).

Fallout activity was measured in snow and rain caught at various altitudes. The results show that less fallout is contained in snow caught at high altitudes than at low altitudes. This fact indicates that snow and rain collect fallout particles by direct process. The capture cross section was calculated. The calculated cross section is proportional to the fallout concentration of snow and rain at sea level. The capture cross section varies between 10^{-1} and 10 m^2/l. This range of values is somewhat smaller than the cross sections calculated from May's Λ, which was obtained by experiments using I^{131}-labeled Lycopodium spores. (auth)

3245 SOME ISSUES CONCERNING PROTECTION OF THE MEDICAL PERSONNEL AGAINST RADIATION HAZARDS IN DEPARTMENTS OF REMOTELY CONTROLLED GAMMA-THERAPY. V. Ya. Golikov, N. I. Zolnikov, A. N. Krongauz, and I. A. Pereslegin (Inst. of Roentgenology and Radiology, Ministry of Public Health, USSR). Med. Radiol., 10: No. 10, 59-62(Oct. 1962). (In Russian)

Data incident to sanitary and dosimetric investigations of work conditions for the medical staff engaged in 11 remote-control gamma-therapy departments in Moscow and other cities of the Soviet Union are presented. Included are time-studies of the placing of patients on the treatment table with different localizations of the lesion, total gamma-radiation intensity yielded by the GUT-CO unit, and irradiation dose to which the medical staff is exposed, while attending to the above treatment procedures. Recommendations as to the improved protection of medical personnel against radiation hazards are also cited. (auth)

3246 REGARDING RADIATION HAZARDS. Donnell W. Boardman. New England J. Med., 267: 572(Sept. 13, 1962).

Within 24 to 36 hr after detonation on July 6 and 24 in the Nevada testing area of 2 thermonuclear bombs of the order of 10 kiloton magnitude, the I^{131} levels of milk from several Utah milk sheds repeatedly exceeded hazardous levels. These findings, reflected in daily I^{131} counts, led the Director of Public Health in Utah to have milk diverted from fluid distribution to milk-products manufacture, thereby permitting time for these dairy foods to become safe for consumer use. In other cities sudden peak levels have also occurred. Thus, Troy, New York, in April, 1953, was exposed by a flash rainstorm, which occurred 18 hr after a Nevada test explosion, to radioactive fallout sufficient to produce levels in milk estimated at more than a 1000 times the safe limit by British or American standards, more than 4 times the British annual allowance in 1 quart of milk. It is suggested that public-health authorities, working in collaboration with the nation's medical centers, should institute routine, daily I^{131} thyroid-uptake counts on the infants in various parts of the country. (H.H.D.)

3247 REGRESSION IN THE CONCENTRATION OF FISSION PRODUCTS IN THE AIR OWING TO PRECIPITATIONS. A. Cervellati, C. Melandri, and O. Rimondi (CNEN, Bologna). Nuovo cimento (10), 23: Suppl., No. 2, 200-20 (1962). (In English)

The possibility of observing statistically the effect of atmospheric precipitations on the concentrations of radioactive products in the air is considered, that is, the degree of correlation existing between the concentration and the number of consecutive days with precipitation. The correlation between the relative reduction of the concentration and the amount of precipitation was found and the relation between these quantities is given. (W.D.M.)

3248 STUDIES OF THE GENERAL BEHAVIOUR OF THE ATMOSPHERIC RADIOACTIVITY IN ITALY IN RELATION TO THE NUCLEAR EXPLOSIONS OF AUTUMN 1958. A. Cervellati, C. Melandri, and O. Rimondi (C.N.E.N., Bologna). Nuovo cimento (10), 23: Suppl., No. 2, 221-52(1962). (In English)

Studies of the general behavior of radioactivity in the atmosphere in Italy from Oct. 1958 to Feb. 1960 are reported. The study was performed with the use of concentration data supplied by the eight stations which constitute the I.G.Y. network. An attempt is made to see whether the behavior of the radioactivity is in agreement with the general theory of diffusion and with the transport of fission products in the atmosphere. (W.D.M.)

3249 ON THE RADIATION QUALITY OF SCATTERED RADIATION IN OUT CLINIC WORK. Haruma Yoshinaga (Hiroshima Univ.), Walter J. Russell, Noritoshi Watanabe, and Tatuo Mandai. Proc. Res. Inst. Nucl. Med. Biol., No. 3, 51-4(1962). (In Japanese)

The radiation dose to which radiologists, x-ray technicians, nurses, and other personnel of the Hiroshima hospitals were exposed, was measured by means of film badges and gamma spectrometers during the period 1958 to 1961. For most hospitals, the character of the scattered dose was 60 to 70 kvp; in some cases values exceeding 100 kvp were obtained. Spectrometric measurements indicated that the scatter was almost of the same order as the primary radiation in the x-ray rooms used for diagnostics but in the treatment rooms which housed 100 to 200-kvp instruments, the scatter was softer than the primary radiation. (TTT)

3250 IMPROVED FERROSULFATE DOSIMETER. S. S. Kuznetsova and I. K. Sokolova. Radiobiologiya, 2: 626-8(1962). (In Russian)

Application of benzene (8×10^{-3} M) as a sensitizer increased the magnitude G(Fe^{3+}) to 53 ion/100 ev. The sensitivity of the ferrous sulfate dosimeter was improved by a factor of 3.2. It is shown that the dosimeter is stable and, with benzene additions, its indexes are linear at 110 to 5500 r and are not functions of dosage at 0.062 to 6.14 r/sec or temperature from 1 to +50°C. (R.V.J.)

3251 STOCKPILING TO SURVIVE A NUCLEAR ATTACK. Albert W. Bellamy (Univ. of California, Los Angeles). Science, 138: 958-60(Nov. 30, 1962).

An adequate civilian defense system has two phases. The first phase demands special structures, including stocked fallout shelters throughout the country and a maximum number of blast-resistant structures in and near population centers, with adequate instruments for detecting and measuring air pollutants and maintaining communications. The second, or recovery, phase requires stockpiling of fuels for operating farm machinery; power sources (fossil or nuclear) for rebuilding the nation's industrial plant; and, above all, stockpiling of food to keep human beings alive and functioning. (R.J.S.)

3252 DANGERS DES RADIATIONS ATOMIQUES. ÉLÉMENTS DE PROTECTION. (Dangers of Atomic Radiation. Elements of Protection). Raymond Devoret. Applications des Sciences Nucleaires. Brussels, Compagnie Belge d'Editions–S.P.R.L. and Paris, Gauthier Villars & Cie, 1961. 147p.

The dangers of atomic radiation and the elements of protection are reviewed for the layman interested in the development of peaceful applications of nuclear energy. The physical characteristics of the interaction of radiation with matter are first reviewed. The effects on man of exposure to radiation are described as a function of the dose received. The actual irradiation of the population and its possible augmentation by the increasing development of radiological examinations, by fall-out from experimental nuclear explosions, and by radioactive wastes produced by the nuclear industry is reviewed. The risks in the occupational manipulation of radiation sources are then discussed. In conclusion, a brief résumé is given of the French regulations on the prevention of accidental exposure and on the reparations for damages caused by radiation. (J.S.R.)

3253 PROPOSED IAEA REGULATIONS FOR THE INTERNATIONAL TRANSPORT OF FISSIONABLE MATERIALS. J. W. Wachter (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). 17p. (TID-17084)

For presentation at AIChE Symposium on Nuclear Safety in Handling Radioactive Fuels, Chicago, Dec. 3-6, 1962.

The International Atomic Energy Agency convened two panels of experts to draft proposals for regulations covering the safe transport of all types of radioactive materials. The general provisions of these proposed regulations are reviewed. Factors affecting the criticality of interacting arrays and the hazards of handling fissile material containers are discussed. (C.H.)

3254 RADIATION PROTECTION AND DENTISTRY. The Postgraduate Dental Lecture Series. Arthur W. Wuehrmann. St. Louis, C. V. Mosby Co., 1960. 238p. $6.50.

3255 DOZIMETRICHESKII KONTROL'NA ATOMNYKH SUDAKH. (Dosimetric Control for Nuclear-Powered Ships). D. V. Lyush and B. N. Nikolaev. Leningrad, Publishing House of Ship Building Industry, 1962. 130p.

Safety rules and dosimetric techniques are described for nuclear-powered merchant vessels and ice breakers. Short descriptions are given of the safety and dosimetric control systems for the ice breaker "Lenin" and for various foreign ships. The boon is designed for the engineering-technical personnel in the ship-building industry, the navy, and for senior students. (R.V.J.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

Refer also to abstracts 3662, 3665, 3666, 3667, 3668, 3669, 3670, 3671, 3673, 3675, 3680, 3681, 3682, 3685, 3697, 3703, and 3704.

3256 (AD-276451) FEASIBILITY STUDY OF A RADIOISOTOPIC POWER SOURCE FOR REMOTE AREA HEATING. Final Report. W. H. Barnes, L. E. Light, and A. A. Totah (Chance Vought Corp., Dallas). Jan. 1962. Contract NBy-37602. 178p. (AER-E1R-13623)

A technical and economic feasibility study was made in order to investigate the use of radioisotopic power as an energy source for remote area heating. Consideration was given to units for a rated output of 50,000 and 300,000 Btu/hr. Designs are presented for a number of feasible systems. The economic study revealed that a Nuclide Heat unit can compete with conventional heaters in remote locations where conventional fuel logistics add measurably to the over-all heating costs and where long lifetime, highly reliable units are required. (auth)

3257 (NP-11563) INDUSTRIAL RADIOISOTOPE TRACER CALCULATIONS. A GUIDE IN PROBLEM SOLVING WITH TYPICAL NUMERICAL EXAMPLES. Robert E. Black (General Motors Corp. Research Labs. [Div.], Detroit). 90p.

The Training Program and its background are discussed briefly. The reasons for teaching problem solving as a separate course are discussed. The plan of organization of lectures and problems is explained. Lecture notes and four sets of problems and their solutions are shown; this material has evolved while being presented to five classes of the Radioisotopes in Industry Training Program. (auth)

3258 (NYO-10411) A STUDY OF THE EFFECTS OF SUB-STERILIZATION DOSES OF RADIATION ON THE STORAGE LIFE EXTENSION OF SOFT-SHELLED CLAMS AND HADDOCK FILLETS. Quarterly Progress Report No. 2, August–October 1962. John T. R. Nickerson and Samuel A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-3006. 19p.

Triangle difference tests were used to establish a starting storage dose level for haddock fillets and soft-shelled shucked clams. The highest storage dose levels were established as 400,000 rad for haddock fillets to be prepared by steaming, 800,000 rad for haddock fillets to be prepared by deep fat frying, and 800,000 rad for soft-shelled shucked clams to be prepared by deep fat frying. No tests by other methods of cooking were included for shucked clams since they are ordinarily used only for frying. Acceptability tests employing the nine-point hedonic scale are being carried out three times after irradiation: immediately post-irradiation, at an intermediate storage time, and at a time near the limit of storage (time of storage determined by an aerobic-facultative count of 1×10^6 bacteria per gram and the limit of storage at some period beyond this). Organoleptic and microbiological tests are being carried out on samples canned under aerobic conditions and under a vacuum of 25 in. of Hg, and stored at temperatures of 43 to 46°F and 32 to 33°F. For haddock irradiated at 200,000 rad (canned with and without vacuum) and held 7 days at 43 to 46°F bacterial counts have been found to be over 1×10^6 per gram. After this period organoleptic tests on the air packed product (fried product) showed no significant difference from the control (frozen) while the vacuum packed product was significantly different from the control (frozen). For haddock irradiated at 200,000 rad (canned with and without vacuum) and held 14 days at 32 to 33°F bacterial counts were less than 1×10^6 per gram. Organoleptic tests indicated that air packed samples were not significantly different from the controls but vacuum packed samples were significantly different from controls after 14 days storage at the temperatures indicated. (auth)

3259 (TID-17024) RADIOISOTOPES RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES. Quarterly Progress Report, June 15 to September 15, 1962 (Fifteenth Quarter). (Chicago. Univ. Labs. for Applied Sciences). Oct. 1962. Contract AT(11-1)-712. 33p. (LAS-SR-161-51)

Efforts during the period were devoted mainly to theoretical investigations and report preparation. Reports being prepared include those on piston ring wear, use of neutron moderation in determination of asphalt content in paving materials, and radiometric determination of iron in ore. Theoretical studies of alpha scattering were continued. (J.R.D.)

3260 RESULTS OF INDUSTRIAL TESTS OF CORN SEEDS IRRADIATED BY Cs^{137} γ RAYS. N. M. Berezina, E. I. Korneva, and R. R. Riza-Zade (Inst. of Biological Physics, Moscow). Radiobiologiya, 2: 629-33(1962). (In Russian)

The results are given from tests made using corn seed irradiated with 500 r at 720 r/mm. Observations during the vegetative period showed an earlier development of the irradiated seeds as compared to controls. Improved quantity and quality (higher protein) of green corn were collected from irradiated seed. (R.V.J.)

3261 SPECIFICATION FOR GAMMA-RADIOGRAPHY SEALED SOURCES. B. S. 3513. London, British Standards Institution, 1962. 15p. 5s.

General constructional requirements, tolerances on source activity and radiation output, and dimensions, both of the radioactive material and the outer capsule for gamma sources of activity up to approximately 100 curies for cobalt-60 or 300 curies for cesium-137 or iridium-192 are specified. Test requirements with regard to freedom from surface radioactive contamination and leak freedom are given, with details of the test methods, and requirements are also laid down concerning the marking of the sources and the provision of source certificates. The specification replaces B.S. 2783 which specified source capsules only. (auth)

3262 LE RADIAZIONI IONIZZANTI PER LA CONSERVAZIONE DEGLI ALIMENTI. (Ionizing Radiation for the Preservation of Foods). Collana di Documenti e di Studi Scientifici 2. Rome, La Documentazione Italiana Editrice, 1961. 131p.

The present knowledge on and future prospects for food preservation using radiation are reviewed. The topics discussed are characteristics, measurement, radiation sources, effect of radiation on microorganisms, factors affecting the radiation sensitivity of microorganisms, enzymes and viruses, secondary effects of radiation, radiation preservation of animal and vegetable food products, radiation of packing materials, and economic considerations. 224 references. (J.S.R.)

INSTRUMENTS AND INSTRUMENTATION

General and Miscellaneous

Refer also to abstracts 2770, 3720, 3721, 3892, 3893, 3894, and 4334.

3263 (HW-SA-2751) PRECIPITATION SCAVENGING AND SPECTRAL APPLICATIONS OF THE HANFORD RAINDROP SAMPLERS. R. J. Engelmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 2, 1962. Contract AT(45-1)-1350. 21p.

A description is presented of a raindrop sampler designed to measure the scavenging of particulate materials by precipitation and to determine raindrop spectra. The samplers use a commercially available, water-sensitive paper. Problems of splash and edge effects are discussed and sample rain spectra are included. (C.H.)

3264 (ORNL-3344) FABRICATION AND ASSEMBLY OF A TEFLON DROPPING-MERCURY ELECTRODE. Helen P. Raaen, R. J. Fox, and V. E. Walker (Oak Ridge National Lab., Tenn.). Nov. 30, 1962. Contract W-7405-eng-26. 37p.

A procedure was developed for fabricating a Teflon dropping-mercury electrode (D.M.E.) that has been shown experimentally to be satisfactory for polarography in glass-corroding media. Because of the lack of a suitable electrode, polarography in such media has not been possible. The electrode consists of a glass-capillary and a Teflon-capillary segment which are attached by guide sleeves to form a unit that behaves as if it were a single segment. Procedures were perfected for precision-lapping a conical end on a glass D.M.E. capillary without plugging the capillary and for fabricating a Teflon segment of specified orifice diameter within a wide range (15 to 110 μ) and to within ± 10 μ. The Teflon segment has a round smooth-walled orifice, a lapped face that is perpendicular to the bore, and a bore of diameter and shape that can be varied. (auth)

3265 (PG-Report-354) THE APPLICATION OF GAS-LIQUID CHROMATOGRAPHY TO THE ANALYSIS OF CORROSIVE GASES. PART 2. THE DESIGN OF IN-LINE CHROMATOGRAPHS. G. Iveson and A. G. Hamlin (United Kingdom Atomic Energy Authority. Production Group, Capenhurst, Ches., England). 1962. 27p.

Declassified version of PG-Report-88.

Development of a gas chromatograph for in-line analysis of material from a diffusion plant is described. Design of various components is also described. (J.R.D.)

3266 (TID-14150) LOGARITHMIC CONVERTER AND INTEGRATOR. J. L. Engle (Institute for Cancer Research, Philadelphia). [Oct. 30, 1961]. Contract [AT(30-1)-2356]. 4p.

A logarithmic converter and integrator circuit, which is used in an ultraviolet flying spot microscope, measures in two seconds a complete 200-line field. Each of the 5 diodes in the circuit has a logarithmic response. The video current is supplied to the log diode from a 50 K resistor fed by a voltage source. The log signal is amplified and then clipped below an arbitrary level to leave only the range of interest. This signal is again amplified and drives a resistor which behaves as a current generator to charge up the integrating capacitor. (M.C.G.)

3267 (TID-15459) NEW DEVELOPMENTS IN ULTRA FAST WARM-UP PLANAR TUBES. J. M. Connelly and D. D. Mickey (General Electric Co. Receiving Tube Dept., Owensboro, Ky.). [Mar. 5, 1961]. Contract [AT(29-1)-789]. 21p.

Present day military weapons systems require the reliability and the high frequency performance made possible by using modern ceramic planar tubes, but in addition, these weapon systems need to possess the ability to perform their mission with a few seconds notice. As a result of this requirement, a new heater-cathode structure has been designed that enables high performance planar tubes to be produced that have a warm-up time of less than three seconds. This paper discusses the methods used to analyze the thermal problems and obtain solutions leading to the achievement of this ultra fast warm-up time. The performance characteristics of planar tubes using this new heater-cathode structure will also be disclosed. This new heater-cathode structure is adaptable to other types of tubes, such as cathode-ray tubes and traveling wave tubes. (auth)

3268 (TID-17254) PERFORMANCE OF CESIUM THERMIONIC DIODES OPERATED IN SERIES-PARALLEL CIRCUITS. J. W. Holland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [1962]. Contract AT(11-1)-Gen-8. 32p.

Electrical power degradation from the operation of many series-parallel circuited cesium diodes in a thermionic reactor must be considered when a nonflattened nuclear power distribution exists over the volume of the reactor core. An experiment was carried out to measure the loss of power and efficiency due to unequal heat inputs to series- or parallel-connected diodes, and to study the operating characteristics of a multiple-diode system. The results were applied to a specific thermionic reactor configuration with a ratio of maximum to minimum diode heat input of 1.85. The minimum degradation of power and efficiency was found to be 41 and 19%, respectively, at optimized operating conditions. (auth)

3269 (TRG-Report-374) ASSESSMENT OF THE INSTITUTE OF WELDING EXPERIMENTAL RADIOGRAPHIC PENETRAMETER. N. Godwin and H. Jackson (United Kingdom Atomic Energy Authority. Reactor Group, Culcheth, Lancs, England). June 5, 1962. 15p. (NPCC-MWP(S)-DGD/P.36)

A series of radiographic tests on steel specimens using an experimental wire penetrameter is described. Results obtained by use of this type penetrameter are compared with those obtained using standard penetrameters. (J.R.D.)

3270 (UCRL-6547) A CATHODE-RAY SWITCH TUBE WITH 11 CHANNELS OF ELECTRON MULTIPLICATION. R. Kalibjian (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 20, 1961. Contract W-7405-eng-48. 23p.

An 11-channel switch tube with 5 stages of electron multiplication was developed. In some applications the switch tube will replace the camera-oscilloscope system for recording the rise times of electrical signals. This tube will be used to convert wide-band information from a single channel into eleven channels of lower bandwidth information which can be transmitted over standard telephone cables for telemetering operations. Venetian-blind dynodes are used for the multiplier structure. Each channel is defined by a pair of louvers on the dynode disk. U-shaped shields which just straddle the louver edge of the preceding

dynode, are used to minimize crosstalk. The channel width is 0.120 inch, or a total length of 1.32 inches for the 11 channels. The collector system provides a method for equalizing the gain of all the channels. The switch tube is 3 inches in diameter and 24 inches in length. Operating at a 4-kv beam potential with 2-μa beam current, the tube provides 20 ma of output current, with less than 5% crosstalk to adjacent channels. The electron optics and the performance of the tube are described. (auth)

3271 (UCRL-7031) DESIGN AND CONSTRUCTION FEATURES OF A VARIABLE GAP THERMIONIC CONVERTER TUBE. W. H. Gust and E. S. McKee (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 27, 1962. Contract W-7405-eng-48. 11p.

Design and construction features are presented for a parallel-plane thermionic converter tube which has an interelectrode gap that may be precisely varied from zero to six inches. (auth)

3272 (UCRL-7085) AN EVALUATION OF VACUUM TUBES FOR LOG N AMPLIFIERS. Emil Sikorsky (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 9, 1962. Contract W-7405-eng-48. 39p.

Thermionic diodes and pentodes (with their associated circuitry) were compared as elements in logarithmic current amplifiers. Diodes generally give greater accuracy, but pentodes have simpler associated circuitry and hence may be preferred for certain applications. Logarithmic-to-linear transfer characteristics and stability were investigated for a number of tube types, and selected types were operated with heater voltage, current, and resistance separately held constant to examine the effects on long term drift. Two logarithmic current amplifiers, one of them designed for radiation resistance, are presented as well as two methods of utilizing vacuum tubes as dynamic logarithmic current sources. (auth)

3273 (UCRL-9726) A PULSED NANOSECOND LIGHT SOURCE. Thomas G. Innes and Quentin A. Kerns (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 4, 1961. Contract W-7405-eng-48. 27p.

A system for scintillations from nuclear events was developed and is presently in use at the Lawrence Radiation Laboratory. The pulsed light source used to simulate nuclear events is described. The necessary nanosecond pulse techniques to measure the light source parameters and to operate large numbers of lamps are discussed. The pulsed light source uses field-emitted electrons to initiate a discharge in hydrogen. The light pulse lasts about 2 nsec and rises in about 1 nsec. Pulse shape of the light is measured by using sampling techniques. The light intensity and the spectral characteristic are both given. Considerations concerning distribution networks are shown. Use of the light source as a spark gap trigger is also discussed. (auth)

3274 (UCRL-9791) THE SIDEBAND TECHNIQUE IN A VARIABLE FREQUENCY NMR SPECTROMETER. J. V. Acrivos (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1961. Contract W-7405-eng-48. 9p.

The advantages of the sideband technique over the derivative method in wideline nuclear magnetic resonance spectroscopy are discussed. (M.C.G.)

3275 (WAPD-T-1270) ACCURACY AND RESPONSE OF THERMOCOUPLES FOR SURFACE AND FLUID TEMPERATURE MEASUREMENTS. S. J. Green and T. W. Hunt (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1961. Contract AT-11-1-GEN-14. 84p.

Methods for accurately measuring surface and fluid temperatures during steady-state and transient conditions have been studied. Most of the temperature measurements are made on test sections that are resistance heated by passing d-c current through them. Because of very limited space for sensors and other practical considerations, thermocouples, using two types of high temperature insulation in a temperature range of from 100 to 1200°F, were considered. (R.J.S.)

3276 (AEC-tr-5080) METHODS AND USES OF MASS SPECTROSCOPY. Heinz Ewald and Heinrich Hintenberger. Translation of "Methoden und Anwendungen der Massenspektroskopie" (a publication of Verlag Chemie, GmbH, Weinheim/Bergstrasse, Germany, 1953). 383p.

The development of mass spectroscopy and the problems and applications which resulted are discussed. Topics covered include: production of ions, ion optics, detection of ions, apparatus, mass and abundance measurements, and applications. The uses described are atomic weight determinations, isotope separation, investigation of nuclear transformation, determination of geological age and paleotemperature scale, investigation of ion formation by electron collision, mass spectra of molecules and chemical problems, and application of enriched stable isotopes as tracers. (M.C.G.)

3277 A GAMMA-RAY DENSITY GAUGE FOR MEASURING WATER-STEAM MIXTURES IN AN ELECTRICALLY HEATED SIMULATED REACTOR FUEL ELEMENT. Olov Nylund. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 305-20(1962). (In English)

In order to find out what happens in a fuel element in the R3/Adam reactor if the coolant is forced to boil, experiments were performed on a full-scale electrically heated test element. The water-steam density distribution was measured with a specially designed density gauge, based on the well-known gamma-ray attenuation principle. The method and the equipment are described and the accuracy is investigated theoretically and experimentally. As an example a measured density distribution is shown and discussed. (auth)

3278 THE SECONDARY-EMISSION ELECTRON MULTIPLIER TUBE USED ON A MASS SPECTROMETER AND ITS AMPLIFICATION OF ION CURRENTS. Toshio Sugiura (Osaka Univ.). Bull. Chem. Soc. Japan, 35: 1257-62(Aug. 1962). (In English)

For the purpose of measuring very small ion currents by the mass spectrometer, a secondary electron multiplier, using the dynodes of copper–beryllium, was constructed and installed. The amplification by the electron multiplier of various supplied voltages to the conversion dynode was measured for inert gas ions, and the amplification factor and its variation with the supplied voltage to the conversion dynode was compared with both the activated and the electropolished dynode. For the electron multiplier using the electropolished dynodes, the amplification was roughly inversely proportional to the square root of the ion mass, while for the activated dynode this was not the case. The average yield of the secondary electrons impacted by electrons on the copper–beryllium dynodes was determined, using the values of γ_1 which had been estimated by extrapolation of the data obtained in a previous study. The increase of the amplification factors of the electron multiplier due to the dynode activation was explained on the basis of an increase in γ_1 and δ due to dynode activation, an increase to be attributed to the formation of beryllium oxide layers. In this study, an amplification factor of a 10^5 order for inert gas ions was obtained with the electron multiplier constructed with dynodes made from activated copper–beryllium. By using this electron multiplier, ion currents of 10^{-19} amperes are easily detectable with a

mass spectrometer using a conventional d-c amplifier. (auth)

3279 HIGH TEMPERATURE W/W–25 Re THERMOCOUPLES. A. R. Driesner, C. P. Kempter, C. E. Landahl, C. A. Linder, and T. E. Springer (Los Alamos Scientific Lab., N. Mex.). Instr. Control Systems, [35:] 4p.(May 1962). (LADC-4987)

Tungsten/W–Re thermocouples have been used successfully for measuring H_2 gas temperature in the Kiwi-A reactors of the Rover nuclear propulsion program. The most useful combination for these thermocouples has been W coupled with a W–25% Re alloy. This alloy exhibits a solidus temperature slightly over 3100°C, has considerably more room temperature ductility than W, and yields an emf of about 40 mvo against W at 2300°C. In one design, 60 mil W and W–Re wires are pressed and swaged into a W block. The wires are passed through an insulated pressure seal. The time response of the thermocouple is in the 1-sec range. (auth)

3280 A DOUBLE-FOCUSSING, ALTERNATE-GRADIENT, MAGNETIC SPECTROMETER FOR MOMENTA UP TO 800 Mev/c. Giancarlo Sacerdoti (Laboratori Nazionali del Sincrotrone, Rome) and Luciano Tau. Nuclear Instr. & Methods, 16: 139-44(July 1962). (In English)

A 40° deflecting magnetic spectrometer has been built for use in experiments with the 1.1 Bev photon beam of the Frascati electrosynchrotron. It consists of two strong-focusing alternate-gradient pole sectors, the first producing a field index n = +25 and the second n = –20, assembled on a single yoke with no straight section in the middle. The curvature radius being 250 cm, a dispersion results of 0.03/cm, and focusing in both horizontal and vertical planes is obtained at 261 cm from the source position. The deflection is horizontal, and angular distributions can be measured from 0 to 180° without allowing the primary beam to strike the magnet. Calibration measurements with a Po^{210} α source which extended 5 cm horizontally and 2.5 cm vertically have given 0.0056 steradians as the availabie solid angle, and have confirmed the position of the conjugate points. (auth)

3281 DATA LOGGING EQUIPMENT FOR NUCLEAR PHYSICS EXPERIMENTS. B. Collinge and F. Marciano (Univ. of Liverpool). Nuclear Instr. & Methods, 16: 145-52(July 1962). (In English)

Examples of errors which have been observed in the manual transcription of readings are used to show that automatic recording of data is necessary in relatively simple experiments. A digital data handling equipment is described which is used when the rate at which data is transferred to paper tape is sufficiently slow to make a de-randomizing buffer store unnecessary. Digital measurements of pulse height, time-of-flight or coincidence patterns are typical data. The basic unit accepts data in parallel on 32 wires. Outputs in various formats are available on 5-hole paper tape for teleprinter input. Particular emphasis is placed on the necessity for monitoring data at all stages. (auth)

3282 AMPLITUDE DISCRIMINATOR CIRCUIT USING TUNNEL DIODES. R. Van Zurk (Commissariat à l'Énergie Atomique, Grenoble, France). Nuclear Instr. & Methods, 16: 157-62(July 1962). (In French)

A pulse amplitude discriminator using Tunnel diodes is described. The circuits are entirely d-c coupled. Several options are possible, allowing a compromise between sensitivity and time resloution. Typical values are: (1) Sensitivity: 12 mV; resolving time: 20 ns. (2) Resolving time: 12 ns; sensitivity: 1 V. (auth)

3283 PRECISE AUTOMATIC CONTROL BY PROTON RESONANCE OF A CONTINUOUSLY VARIABLE MAGNETIC FIELD. C. H. Vincent, D. Kaine, and W. G. King (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods, 16: 163-75(July 1962). (In English)

An improved form of a highly accurate continuously variable automatic frequency control system previously described is used to adjust the frequency of the marginal oscillator in a proton resonance magnetometer. The oscillator output is amplified, rectified, and further amplified as a video signal. The proton resonance signal thus obtained is applied to a phase-sensitive rectifier which uses the mains supply voltage as reference, as mains current is used to provide the sweep field for the probe. The output of the phase-sensitive rectifier controls a servomechanism which adjusts the magnet current and thus holds its field at the value demanded, to a fraction of an oersted. The present range of the equipment is 1,000 to 10,000 oersted. (auth)

3284 A TRANSISTORIZED TRIPLE PULSE GENERATOR. P. Polly (Institut für Radiumforschung und Kernphysik, Vienna). Nuclear Inst. & Methods, 16: 221-6(July 1962). (In German)

A transistorized triple pulse generator has been developed. By its plug-in construction the instrument is highly flexible. The fundamental instrument consists of a frequency generator, an oscilloscope trigger stage, three variable delays and three pulse forming stages. From this fundamental instrument can be derived: a triple pulse generator or a single and a double pulse generator (in the latter case only an additional frequency generator is necessary). The frequency generator can be operated free running (1 c/s-300 kc/s), externally triggered, triggered from line (50 c/s) or with single pulses (by push-button operation). The delays and the oscilloscope trigger stage have a range of 1 μsec-3 msec delay. The pulse formers give square waves of max. 10 V amplitude (positive or negative); there can be derived single, double or triple pulses. The instrument is intended mainly for testing transistorized nuclear equipment, but on account of its high flexibility it can be applicated to many electronic uses. (auth)

3285 A FAST TRANSISTOR SCALER FOR DECIMAL COUNTING. K. S. Kuchela (Atomic Energy Establishment, Trombay, India). Nuclear Instr. & Methods, 16: 287-8 (July 1962). (In English)

A single circuit for realizing the 4-2-2-1 code in decimal counting circuits is presented. The arrangement can be used with advantage when the conventional circuit techniques fail to achieve higher counting speeds, because of inherent RC delays in the feedback paths. By adopting direct coupling using diodes, faster transitions have been achieved. (W.D.M.)

3286 QUANTUM NOISE IN LINEAR AMPLIFIERS. H. A. Haus (Massachusetts Inst. of Tech., Cambridge) and J. A. Mullen. Phys. Rev., 128: 2407-13(Dec. 1, 1962).

The classical definition of noise figure, based on signal-to-noise ratio, is adapted to the case when quantum noise predominant. The noise figure is normalized to "uncertainty noise." General quantum mechanical equations for linear amplifiers are set up using the condition of linearity and the requirement that the commutator brackets of the pertinent operators are conserved in the amplification. These equations include as special cases the maser, the parametric amplifier, and the parametric up-converter. Using these equations the noise figure of a general amplifier is derived. The minimum value of this noise figure is equal to 2. The significance of the result with regard to a simultaneous phase and amplitude measurement is explored. (auth)

3287 HIGH SPEED INFRARED BOLOMETER. Morton Camac and Robert M. Feinberg (Avco-Everett Research Lab., Everett, Mass.). Rev. Sci. Instr., 33: 964-72(Sept. 1962).

A new type of heat transfer gage that operates in the presence of highly ionized plasmas and in strong electric and magnetic fields has been developed. The principle of its operation is to use a thin opaque surface as the heat transfer element. Aerodynamic and radiative heating is applied to one side of this layer, while measurements are made of the change of the infrared emission from the other side. This system is essentially a bolometer. Since the gage is initially at room temperature, the predominant radiation from the opaque layer is in the infrared band from 5 to 30 μ. Changes in the temperature of the element are determined by the variation in its infrared emission. The opaque layer is made thin enough so that the temperature of the front surface can be determined in less than 0.1 μsec. This paper describes the components of the heat transfer system and the methods for calibrating the gage for heating pulses of long and short duration. Gage calibrations by heat pulses from shock heated air are presented, and the response time of the gage to short heat pulses is evaluated. (auth)

3288 OPTICAL EMISSION LINE PROFILE ANALYZER. F. R. Scott, E. N. Dacus, and R. G. Tuckfield, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Rev. Sci. Instr., 33: 1001-2(Sept. 1962).

Recently fiber optics have been used to record the spectral shape of optical emission lines from plasmas. The adaption of an alternate method of spectral analysis to a modest, low-dispersion spectrograph permitting observation of the profile of moderately broad emission lines from dense plasma in a single discharge is reported. (W.D.M.)

3289 SENSITIVITY OF AN ION PUMP LEAK DETECTOR. A. E. Barrington (Varian Associates, Palo Alto, Calif.). Rev. Sci. Instr., 33: 1045-6(Oct. 1962).

An analysis of the parameters governing the performance of a sputter-ion pump leak detector using oxygen or helium as the probe gas is presented. It is shown that the smallest detectable leak is proportional to the stability of the pump current and to the pressure. For optimum performance the pump control unit has to be voltage-stabilized. Expressions for the leak rate and minimum detectable leak in terms of the change of pump current are derived which predict an ultimate capability at least equal to that of conventional mass spectrometer leak detectors. This was confirmed experimentally. (auth)

3290 HIGH SPEED INSTRUMENT FOR QUANTITATIVE MAPPING. Donald R. Green (General Electric Co., Richland, Wash.). Rev. Sci. Instr., 33: 1079-81(Oct. 1962). (HW-SA-2568)

A new, high speed instrument for mapping the magnitude of a variable, such as temperature, vibrational amplitude, radiation, height, etc., at different positions on a surface is described. This instrument records the values of the variable as broken line segments on a two-dimensional map. The position and length of each line segment represent the position and associated average value of the variable during the recording of that particular line segment. Visible density of the map is greater within regions of greater line length so that a qualitative picture is obtained at a glance. A quantitative measurement can be obtained from the map with a ruler. The present instrument was designed for application to heat transfer testing of nuclear fuel elements. However, the method may have applications in any field where it is desirable to superimpose a quantitative record on a qualitative picture. (auth)

3291 SYSTEM FOR PROCESSING AND RECORDING EXCITATION FUNCTION DATA. Robert M. St. John, Chun C. Lin, R. L. Stanton, H. D. West, J. P. Sweeney, and E. A. Rinehart (Univ. of Oklahoma, Norman). Rev. Sci. Instr., 33: 1089-94(Oct. 1962).

A system which automatically processes optical excitation data is described. This system is capable of producing data faster and of better quality than the old method. The apparent cross section for excitation by electron impact of a particular state is proportional to the light intensity of a radiative transition from this level divided by the product of the electron beam current times pressure. The light intensity is measured from the output current of a photomultiplier tube. When the pressure in the collision chamber is maintained constant, the apparent cross section is proportional to the ratio of photomultiplier current to electron beam current. This ratio is continuously computed by an analog divider while the electron accelerating voltage power supply is slowly swept through its range by a motor and gear reduction system so as to give a visual display of the excitation function on an oscilloscope. Permanent records of the function are made by photographing the trace. Absolute values of the excitation function can be obtained by calibration against a standard lamp. In order to suppress noise and light signals not originating in the collision chamber, the light beam from the collision chamber is square wave modulated; this then is converted into a sinusodial wave by means of a tuned amplifier. This in turn is rectified by a phase-sensitive detector which produces a dc voltage proportional to the signal light intensity. Circuits of the phase-sensitive detector and modulation unit are presented. (auth)

3292 APPARATUS FOR THERMOLUMINESCENCE MEASUREMENTS. G. Bonfiglioli, P. Brovetto, and C. Cortese (Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin). Rev. Sci. Instr., 33: 1095-1100(Oct. 1962).

A description is given of an apparatus for thermoluminescence experiments with the following special features: a constant rate of warming with time obtained through a suitable cam; light detection making use of phase rectification to reject noise; a special furnace to record "glow current curves" simultaneously. Also, the possibility of "flattening" the spectral response of a photomultiplier (between 2000 and 6000 Å) is investigated and the method of calculating a suitable optical filter is outlined. The performance of the apparatus was quite satisfactory, in spite of the rather simple and relatively inexpensive construction of each part. (auth)

3293 FLASH THERMAL-DIFFUSIVITY MEASUREMENTS USING A LASER. H. W. Deem and W. D. Wood (Battelle Memorial Inst., Columbus, Ohio). Rev. Sci. Instr., 33: 1107-9(Oct. 1962).

The single-heat-wave (flash) method with a time vs temperature amplitude measurement on the back face was chosen for measuring the thermal conductivity of coated fuel-particle specimens. For the flash, a laser beam from a Cr-doped ruby rod was selected. The apparatus for use with the flash method is described. Experimental thermal conductivity data are plotted vs temperature for 7087 graphite, type 347 stainless steel, and a typical coated fuel-particle specimen. (D.L.C.)

3294 ROTATING MIRROR CAMERA SYNCHRONIZING UNIT. R. L. Schellenbaum (Sandia Lab., Albuquerque, N. Mex.). Rev. Sci. Instr., 33: 1112-13(Oct. 1962).

A unit is designed for synchronizing a noncontinuously writing rotating mirror camera with the event to be photographed. The unit comprises two circuits, one composed of squaring and differentiating stages for producing pulses and the other of amplifiers driving a resonant reed unit. The accuracy of the rotating mirror frequency-sensing function was measured to be ±0.14%, and a maximum jitter of ~1.5 μsec was found. (D.L.C.)

3295 ON THE SPACE CHARGE EFFECT IN A VELOCITY MODULATION TYPE MASS SPECTROSCOPE. Tomonao Hayashi. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 56: 206-8(Sept. 1962). (In English)

An expression is given for the resolving power of a velocity modulation type mass spectroscope under the influence of the ion space charge. With this result, the amount of maximum ion current which can be dealt with for a given resolving power is made estimable. (auth)

3296 DESIGN CONSIDERATIONS FOR MAXIMUM BANDWIDTH IN TRANSISTORIZED PULSE AMPLIFIERS. C. W. Williams and J. H. Neiler (Oak Ridge National Lab., Tenn.). IRE (Inst. Radio Engrs.), Trans. Nucl. Sci., NS-9: No. 5, 1-6(Nov. 1962).

Each of the transistor biasing configurations — common-emitter, common-base, and common-collector — has disadvantages which greatly limit the use of cascaded, single-transistor stages for general wide-band amplification. Careful choice of a combination of biasing configurations in a single stage permits optimum use of the advantages of each configuration while minimizing the effects of the disadvantages. Considerations leading to the design of an acceptable wide-band pulse amplifier stage are discussed. These principles have been applied to the design of a one-stage feedback amplifier, which has the following characteristics: gain = 25.8 db, rise time = 2.8 nsec, and linear amplification of either positive or negative pulses. (auth)

3297 REDUNDANT PULSE AMPLIFIER. Toivo A. Somer (Bendix Corp., Detroit). IRE (Inst. Radio Engrs.), Trans. Nucl. Sci., NS-9: No. 5, 7-16(Nov. 1962).

A redundant transistorized pulse amplifier is described, composed of a remote preamplifier operating at −80°C and a main pulse amplifier. Active parallel redundancy is used in the preamplifier as well as the main amplifier. Common feedback between the parallel redundant amplifiers stabilizes the voltage amplification in spite of component failures in one signal path. Delay-line pulse shaping is employed to reduce noise and to eliminate the detrimental effects of pulse pile-up. (auth)

3298 HIGH ACCURACY LOW CURRENT DIGITAL INTEGRATOR. Israel Pelah and Dan Maydan (Israeli Atomic Energy Commission, Rehovoth). IRE (Inst. Radio Engrs.), Trans. Nucl. Sci., NS-9: No. 4, 27-31(Nov. 1962).

A semiconductor current digital integrator is described for measuring currents as low as 10^{-9} amps with an accuracy better than 0.02% and a dynamic range of 10^4. This is accomplished by comparing two currents by means of a two-channel instrument. Using only one of the channels, the accuracy is 0.1% and the dynamic range is 10^5. (auth)

3299 HIGH VOLTAGE DIVIDER FOR IMAGE INTENSIFIER TUBES. Thomas W. Hoffer (Argonne National Lab., Ill.). IRE (Inst. Radio Engrs.), Trans. Nucl. Sci., NS-9: No. 5, 48-50(Nov. 1962).

A corona-free voltage divider with adjustable lens voltages was designed which gives excellent protection to the operator from the high voltage. The divider was built in a box made out of lucite sheets, and a grounded panel is provided between the divider and the operator. Corona-free connectors for 50 and 60 kv were also fabricated. Corona problems and their minimization are discussed. (D.L.C.)

3300 THERMOELECTRIC DEVICES. Gary D. Jones (to General Electric Co.). U. S. Patent 3,064,064. Nov. 13, 1962.

A thermoelectric device is described that includes flexible means for interconnecting the elements. The device is thus capable of withstanding forces that might otherwise fracture the soldered joints. (R.J.S.)

Radiation Detection

Refer also to abstracts 2776, 2781, 3197, 3658, 3677, 3683, 3684, 3726, and 3729.

3301 (AD-275139) RESEARCH INVESTIGATION OF p-i-n ELECTRON JUNCTION DETECTORS. Interim Engineering Report No. 3, January 1, 1962 through March 31, 1962. (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). Apr. 1962. Contract NObsr-85511. 17p.

The dosimetric properties of p-i-n junction radiation detectors were examined from the point of view of determining their usefulness when operated in a current generating mode in medium dose rate electromagnetic radiation fields. The dose rates utilized varied from approximately 2 to 100 r/min. Reproducibility was established when the detectors were used in this mode if only the change in dark current rather than the total current was considered. Wavelength dependence was approximately that which would be expected from theoretical considerations. (auth)

3302 (AD-276079) SILICON JUNCTION RADIATION DETECTOR. Quarterly Report No. 11, January 1, 1962 to March 31, 1962. C. D. Wilburn and R. L. Williams (RCA Victor Co., Ltd. Research Labs., Montreal). Contract DRB-900102. 20p.

Continued research is presented on a silicon junction radiation detector. Results were obtained from alpha particle detectors with transistor structures. All the devices prepared have oxide passivated planar junctions. While several batches of devices were made, only those which showed improved characteristics and offer the possibility of yielding fruitful information are discussed. The encapsulation difficulties with the NPPIN devices were partially overcome and the devices are now being assembled with a rigid structure that gives adequate thermal dissipation for most alpha particle pulse measurements under vacuum. (auth)

3303 (AFOSR-2669) A SYSTEM FOR AUTOMATIC DENSITOMETRY FOR THE MEASURING AND CALCULATION OF RADIATION DOSE DISTRIBUTION. Technical Note No. 3. Bengt G. Karlsson and Boerje Larsson (Uppsala Univ. Gustaf Werner Inst. for Nuclear Chemistry). Feb. 20, 1962. Contract AF61(052)-183. 12p. (AD-276062).

The usefulness of the method of experimental radiosurgery of the brain depends on a careful planning of the operative procedure, the shape of the lesion being related to the distribution of isodose curves in the tissue. A system for automatic densitometric measurements was developed which permits automatic evaluation of dose distributions in volumes of various size by means of photographic emulsions or in-phantom chemical dosimeters. The apparatus is also convenient for the semi-automatic calculation of dose distributions in multiple field procedures. (auth)

3304 (AWRE/LIB/BIB/5) PROPORTIONAL COUNTERS. BIBLIOGRAPHY OF PUBLISHED PAPERS AND UNCLASSIFIED REPORTS, FEBRUARY 1962. Dorothy Beck (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Sept. 1962. 30p.

The references are presented in sections on principles of operation, specific descriptions, high-pressure proportional counters, performance, gas gain, pulse shape and amplifier design, pulse amplitude analysis, gas purity, photo absorption, coincidences, energy expenditure, and applications. A total of 239 references is included. (J.R.D.)

3305 (HW-68069(Rev.)) SEMI-PORTABLE AIR PARTICULATE MONITOR FOR MIXED FISSION PRODUCTS. D. P. Brown, M. O. Rankin, and W. G. Spear (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 22, 1961. Contract [AT(45-1)-1350]. 13p.

A semi-portable air particulate fission product monitor was developed which will detect one MPC of any mixed fission product nuclide except $Sr^{90}-Y^{90}$ in 14 minutes in typical gamma backgrounds or in 140 minutes in gamma backgrounds of 1 mr/hr assuming build-up on the filter from naturally occurring radon and thoron products does not exceed 400 counts/min. (auth)

3306 (LADC-5427) NEW METHODS OF NEUTRON DOSE RATE EVALUATION. Dale E. Hankins (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 23p.

A multisphere unit and a single 10-in. sphere instrument were developed for evaluating neutron dose rates. Using either of these methods, the dose rate from reactor leakage neutrons can be determined, including those neutrons in the intermediate energy region. The multisphere method utilizes three cadmium-covered polyethylene spheres of various sizes that are placed over a LiI thermal detector. Because of the different amounts of moderation and absorption of the impinging neutrons, each of the spheres gives a different counting rate for a given neutron spectrum. The efficiency of each sphere over a wide energy region is known; and by assuming that the neutrons in the intermediate energy region have a 1/E dependence, it is possible to determine the simplified spectrum from the observed count. From this spectrum one obtains the fraction of intermediate neutrons, the fraction of fast neutrons, and the approximate average energy of the fast neutrons. The dose rate delivered by the neutrons can then be calculated. The single sphere method utilizes a 10-in. polyethylene sphere placed over a LiI thermal detector. This size sphere has a response approximately proportional to the dose rate for neutron energies from thermal to 7.0 Mev. The 10-in. sphere responds to thermal neutrons within 4%, and to fast neutron energies below 7.0 Mev within 15% of the actual dose rate. The intermediate energy neutrons produce a weighted overestimate of 80% for a 1/E spectrum extended to 1 Mev. The error in the total dose rate ranges up to an observed maximum of 65% when all energy groups are measured. No assumptions concerning the spectrum are required for the single sphere instrument; it can be used as a survey instrument for neutron energies from thermal to 7.0 Mev. The total neutron dose rate is reported with reasonable accuracy, irrespective of the neutron spectrum, and the dose rate is given by direct readout. A comparison of the total dose rate determined by both techniques and the Hurst type absolute fast neutron detector is given for the various types of sources and for reactor leakage neutrons. (auth)

3307 (LAMS-2764) A MONTE CARLO CALCULATION OF THE NEUTRON DETECTION EFFICIENCY OF A HYDROGEN BUBBLE CHAMBER. J. K. Wooten and H. C. Bryant (Los Alamos Scientific Lab., N. Mex.). Sept. 1962. Contract W-7405-eng-36. 20p.

The calculation of the efficiency of the Los Alamos hydrogen bubble chamber for detection of neutrons in the energy range 5 to 35 Mev was done using a Monte Carlo technique. The detection efficiency was calculated as a function of energy of the neutron and angle of the proton recoil. (auth)

3308 (NP-12226) A PROTON RECOIL NEUTRON SPECTROMETER UTILIZING A SEMICONDUCTOR RADIATION DETECTOR. Final Report. S. S. Friedland, F. P. Ziemba, and E. L. Zimmerman (Solid State Radiations, Inc., Los Angeles). [1961]. Contract DA-49-186-ORD-1013. 72p.

A proton recoil neutron spectrometer utilizing a thin hydrogenous radiator and a semiconductor detector has been built and evaluated. The essential features of the instrument are shown and described. The proton energy spectrum emitted from the radiation is observed by the detector and low noise amplifier system and displayed by a multichannel analyzer. Two low noise amplifiers have been designed and constructed. The first is a Nuvistor hybrid amplifier with a noise level equivalent to 4 kev FWHM. The second is a fully transistorized cascade amplifier with a FWHM in the range of 8 kev. The proton recoil instrument has been evaluated and found to have an upper energy cut off due to the (n,p) reaction in silicon above 6 Mev. The lower limit is set by the hydrogenous radiator and the noise level of the detector-amplifier system and the entrance window of the detector. A theoretical study based on an empirical slowing down relationship for protons was developed in order to predict the detailed response of the system having a range of radiator thicknesses and geometries. A graphic solution is presented which is applicable to poor geometry or large angle cases as well as thick radiator foils. Experimental observations using a d-d neutron source yielded proton energy distributions in substantial quantitative agreement with the calculations. A strong γ background has been shown to affect the resolution of the instrument. A γ level of 100r/min produces at least a fivefold increase in the FWHM. (auth)

3309 (NP-12265) A CHERENKOV DETECTION SYSTEM FOR USE WITH A LIQUID SCINTILLATION SYSTEM TO INVESTIGATE INTERACTIONS OF HIGH ENERGY MUONS WITH HEAVY NUCLEI (thesis). Research Report No. S-2. Thomas Donald Tuttle (United States Naval Academy, Annapolis, Md.). June 1961. Contracts NR 015-909 and Nonr-2249(04). 33p.

A Cherenkov detector for use in selecting high-energy muons from sea level cosmic radiation is described. The detector employs two water-filled cylinders in a vertical arrangement, and by coincidence techniques provides a fairly well-defined beam of high-energy muons with a flux of about 36 hr^{-1}. It is designed to operate in conjunction with a liquid scintillation system for the investigation of interactions with heavy nuclei. (auth)

3310 (ORNL-3090) PULSE HEIGHT CALCULATIONS FOR A PARALLEL PLATE IONIZATION CHAMBER CONTAINING ELECTRON ATTACHING GASES. H. B. Eldridge (Oak Ridge National Lab., Tenn.). Nov. 21, 1962. Contract W-7405-eng-26. 23p.

When the pulse from a parallel plate electrode ionization chamber containing an attaching gas is examined with a linear pulse amplifier having the proper integration and differentiation time constants, the pulse height is an analytic function of the attachment coefficient and the electron drift velocity. The expressions for the pulse height as a function of the partial pressure of the attaching gas, electron drift velocity, attachment coefficient, chamber geometry, and amplifier time constants are evaluated and presented in tabular form. (auth)

3311 (PPAD-454E) CLEARING TIME IN MAGNETIC FIELD SPARK CHAMBERS. F. W. Murphy, Jr. and G. K. O'Neill (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Mar. 1962. Contract AT(30-1)-2137. 10p.

Electric fields commonly used to reduce sensitive time in a spark chamber introduce some problems, such as shifts in spark positions, when the spark chamber is used in a magnetic field. The usefulness of chemical clearing agents (gases with electron affinity) should not, however, be affected by magnetic fields. It is found that ½% SO_2 in Ne at 1.3 atm. in a spark chamber with 50 3-mm gaps reduces track efficiency at 2 μsec total delay to less than 20% of the efficiency at 0.39 μsec, and is substantially unaffected by 10 kgauss field, while 1% SO_2 clears even faster. (auth)

3312 (PPAD-465D) TEMPERATURE REGULATION OF THE 15 INCH HYDROGEN BUBBLE CHAMBER. R. L. McIlwain (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Aug. 31, 1962. Contract AT(30-1)-2137. 38p.

The proposed temperature control system of the Princeton-Pennsylvania 15 inch bubble chamber is described. This consists of a neon vapor pressure thermometer for calibration purposes, a carbon resistance thermometer to operate a servo system to regulate the chamber temperature, and a thermocouple network to sense temperature differences at various points on the chamber body. The servo system controlling the coolant flow is described in detail and some possible nonlinearities in this control are anticipated. (auth)

3313 (UCRL-7068) He^3 GAS SCINTILLATION NEUTRON DETECTOR. W. C. Dickinson and A. Lauzon (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 28, 1962. Contract W-7405-eng-48. 41p.

A He^3 gas scintillation neutron detector was built and used to measure the flux of epithermal neutrons in the Gnome event of December 10, 1961. The general characteristics of such detectors are described and results of scintillation efficiency measurements of several He-Ar mixtures as a function of amount of added N_2 wave-length shifter are included. The construction details of the field detector are given and its response to high-energy bremsstrahlung and thermal neutrons is described. The Gnome neutron flux spectrum as measured with this detector is shown. (auth)

3314 (UCRL-10275) FOUR-π FAST-NEUTRON SPECTROMETERS FOR DETECTION AND DOSIMETRY. Roger Wallace (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 18, 1962. Contract W-7405-eng-48. 23p.

The proton-recoil and gamma-ray pulse-shape discriminating, He^3, He^4, Li^6, double pulsing, moderated BF_3, nuclear emulsion, threshold, and semiconductor types of 4π neutron spectrometers are described. These nine types are compared as a function of neutron energy on the basis of absolute sensitivity and energy resolution. Recent developments in the pulse-shape discriminating and semiconductor types are outlined. Experimental calibrations of several of the more promising types are included. The discrimination against gamma rays of each type is described. The application of these instruments to neutron field dosimetry measurements of biological significance is discussed. (auth)

3315 (USNRDL-TR-586) A PORTABLE COMBINATION DOSE-DOSERATE METER. R. L. Hopton (Naval Radiological Defense Lab., San Francisco). Oct. 1, 1962. 27p.

A battery-operated portable combination ratemeter-dosimeter has been developed which will measure gamma radiation rate from 0–1000 r/hr in three linear decade ranges. Simultaneously, the integrated dose may be read from a digital display whose range is 0–999.9 r. The least count on the digital register is 0.1 r. The rate may be read with an accuracy of less than ±10 percent between −40 and +50°C. The integrated dose from Co^{60} isotope may be read to 0.1 r or ±10 percent, whichever is greater, from −40 to +50°C. Battery life, using two C size nickel-cadmium rechargeable cells is in excess of 40 hr per charge. Package weight, including battery, is less than 3 lb, and size is 4 by 4 by 7 in. (auth)

3316 (Y-1402) ABSORPTION AND GEOMETRY EXPERIMENTS IN GAMMA SPECTROMETRY OF URANIUM WITH A LARGE SCINTILLATION DETECTOR. R. E. Cofield (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Oct. 23, 1962. Contract W-7405-eng-26. 15p.

Counting geometry and radiation absorption studies were performed for point and bulk U-235-enriched uranium sources, using a 9-inch by 4-inch scintillation detector and untempered Masonite absorbers. The absorption data was collected for comparison with a mathematical computer model of the Y-12 In Vivo Radioactivity Measurement Facility counting arrangement. (auth)

3317 A QUENCHING CIRCUIT FOR SELF-QUENCHING GEIGER-MÜLLER ARRAYS. Vasco Caini and Ingrid U. Olsson (CAMEN, Pisa, Italy and Inst. of Physics, Uppsala). Arkiv Fysik, 22: 225-35(1962). (In English)

A fast-acting, stable quenching circuit is designed, as a means of prolonging the lifetime of Geiger-Mueller tubes that are required to operate continuously for periods of years. When ionization builds up to a certain point in the G-M tube, the quenching circuit provides a negative pulse at the G-M anode, after which the anode voltage remains about 100 v below its normal value for about 1 μsec. (T.F.H.)

3318 A LOW-NOISE CHARGE-SENSITIVE PREAMPLIFIER FOR SEMI-CONDUCTOR IONIZATION CHAMBERS. J. Moritz and H. J. Tauffenbach (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Ger.). Atomkernenergie, 7: 330-1(Sept. 1962). (In German)

A low-noise charge-sensitive preamplifier for particle spectroscopy with junction detectors is described. Using an E 280 F as input tube a noise width of 2.9 kev (fwhm) is achieved. The open-loop gain is in excess of 1800. The noise width as a function of the external input capacity is measured. Without a feedback capacitor the circuit may be used as a voltage-sensitive preamplifier with an extremely good noise performance. (auth)

3319 NUCLEAR INSTRUMENTATION. NO. 11. Instr. Nucl., No. 11, Suppl. Bull. Inform. Sci. Tech. (Paris), No. 60, 1-23(Apr. 1962). (In French)

In the first part the methods used for testing proportional amplifiers are described in some detail. The second part gives a description of new instruments developed by the

CEA. The instruments discussed are detectors, counting apparatus, personnel protection devices, measurement devices, and separate pieces. (J.S.R.)

3320 DIRECTIONAL RESOLUTION AND SHIELDING PROPERTIES OF A LONG COUNTER. S. Boerresen, B. Grimeland, and S. Messelt (Univ. of Oslo). Nuclear Instr. & Methods, 16: 135-8(July 1962). (In English)

Two long counters have been examined. The thickness of the outer paraffin layer was 7.5 cm and 19.5 cm, respectively. For measurements of fluxes from point sources or in well defined beams the thinner shielding was sufficient. In cases of less unidirectional fluxes the thicker shielding will be advantageous. (auth)

3321 NOTE ON MOMENT ANALYSIS OF DELAYED COINCIDENCE EXPERIMENTS. T. Sundstroem (Univ. of Uppsala). Nuclear Instr. & Methods, 16: 153-6(July 1962). (In English)

The methods for moment analysis of delayed coincidence experiments are discussed, and the statistical error which affects the result is investigated. When the measured coincidence corresponds to a decay which is not purely exponential, moment analysis can be utilized for determination of the decay function. (auth)

3322 CALIBRATION OF SOLID STATE P-N DETECTORS WITH ALPHA AND HEAVY HIGH-ENERGY PARTICLES. J. Colard and J. Gal (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Nuclear Instr. & Methods, 16: 195-8(July 1962). (In English)

The ionization defect for solid state p-n function detectors was accurately measured for fission fragments. It was found to be 4.4 ± 1 Mev for the light fragments and 6.4 ± 1.9 Mev for the heavy fragments. A method to calculate the absorption of energy in the dead layer for these fragments was developed, so that the linearity of the pulse height versus energy curve, for heavy high-energy particles, could be conserved when calibrated with α particles. (auth)

3323 A MAGNETIC SPECTROMETER FOR NEUTRON CAPTURE EXPERIMENTS. G. Baeckstroem (Inst. of Physics, Uppsala), A. Baecklin, N. E. Holmberg, and K. E. Bergkvist. Nuclear Instr. & Methods, 16: 199-213(July 1962). (In English)

A 50 cm radius double-focusing spectrometer is described, which is used for measuring internal conversion spectra following neutron capture. A collimated neutron beam interacts with a target inside the spectrometer. A target area of 20 cm^2 may be used at a line half-width of 0.18% due to a special arrangement involving electrostatic acceleration. The magnetic field is regulated to a few parts in 10^5, and data are taken automatically. Preliminary results are shown. The instrument may also be used for gamma-ray experiments, with either Compton electrons or photo-electrons. (auth)

3324 A TRANSISTORIZED SINGLE CHANNEL PULSE HEIGHT ANALYZER. P. Polly (Institut für Radiumforschung und Kernphysik, Vienna). Nuclear Instr. & Methods, 16: 214-20(July 1962). (In German)

A fully transistorized single channel pulse height analyzer has been developed. The instrument has been designed for use with transistor amplifiers but can be used with valve amplifiers as well (with the help of a 1:10 attenuator). It can be used in two kinds of operations: as normal single channel and as double discriminator with two independently adjustable thresholds. Furthermore it can be operated with input pulses with rise-times from 0.1 to 20 μsec; pulse heights from 0.07 to 10.0 V can be analyzed. The stability of the threshold is 0.1% over long periods, the temperature coefficient is less than 0.02%/°C. The channel width is independent from the channel position within 1% (from the channel width). By a special design the accuracy of measurements of low energy spectra together with a strong high energy underground is improved. (auth)

3325 EXPERIMENTS ON CHARGED PARTICLE DISCRIMINATION BY AN IONOGRAPHIC METHOD. R. Stein, H. Eberle, and R. Oppel (Centre de Recherces Nucleaires, Strasbourg). Nuclear Inst. & Methods, 16: 240-6(July 1962). (In French)

In order to study fragments and hyperfragments emitted in very high energy reactions, an ionographic photometer was designed, based on the measure of a track surface for a given length (or track width). This track surface is measured by comparing the results obtained by track examination step by step, with two slits, on a projection on the track through a projection microscope. The magnification is about 4000 times, then in this case the classical mechanical errors are negligible. For calculation of a real surface the real track length and its dipping was taken into account. Methodologic results of discrimination in an ILFORD G 5 emulsion for carbon, neon, and argon are given. (auth)

3326 THE γ-RAY PERFORMANCE OF A LARGE VOLUME PLASTIC SCINTILLATOR. T. A. Iinuma and P. R. J. Burch (Univ. of Leeds, Eng.). Nuclear Instr. & Methods, 16: 247-61(July 1962). (In English)

The γ-ray spectral spread and the background count of a large plastic scintillator (20" × 10" × 6½") viewed by two 7" diameter photomultipliers (20th Century VMP/11/170 or E.M.I. 9623) were investigated. The spectral spread on the high energy side was compounded of three independent factors: (1) Statistical, (2) Geometrical, (3) Intrinsic, and contribution of each factor to the total spread was calculated from experimental γ-ray spectra. The first two factors were then independently estimated (1) by determining the average number of photoelectrons released by a known energy deposition in the scintillator, and (2) by directing collimated beams of γ-rays (from Cs^{137} source) into the scintillator. It was found that the optimum performance could be obtained by applying proper distribution of high voltage on the photomultiplier and by using short light guides. The background spectra (0–3 Mev γ-ray energy) was obtained inside a steel cubicle (5" thick wall) and additional 1" lead shielding reduced the background by 25%. The radioactivity of the photomultiplier and its contribution to the total background were measured. The perspex light guide (1" or 1½" thick) reduced the background by about 10% which was due to the photomultiplier radioactivity. The photomultiplier noise which determines the lowest measurable energy was found to be an increasing function with the voltage between photocathode and first dynode. Finally, the two types of 7" photomultipliers (VMP/11/170 and 9623) showed almost the same performances at their best conditions. (auth)

3327 DIGITIZED SPARK CHAMBERS. F. Krienen (CERN, Geneva). Nuclear Instr. & Methods, 16: 262-6 (July 1962). (In English)

A new nuclear instrument for the detection of ionizing particles is described. The instrument operates in the manner of a spark chamber in which the ionization due to the passage of an ionizing particle is amplified by means of a strong pulsed electric field resulting in an electrical discharge. The instrument described differs from the conventional spark chamber in the way in which the information is used to record the passage of the ionizing particle. The

currents produced during the electrical breakdown of the gas in the chamber are suitably shaped and forced to follow specific current paths which are linked with a magnetic memory system. From thereon the data may be readily available for further processing by conventional means. (auth)

3328 CONSECUTIVE AMPLITUDE ANALYSES FOR SIMULTANEOUS PULSES. D. F. Hebbard (Australian National Univ., Canberra). Nuclear Instr. & Methods, 16: 267-74(July 1962). (In English)

A transistor circuit is described which can accept pulses for amplitude analysis from two separate sources. The associated pulse height analyser must have the facility of external control of its memory sections. The pulses from the two sources may occur in time coincidence all or part of the time. The sections of the analyser memory in which storage occurs are determined by the sources of origin of the pulses and by the presence or absence of a pulse in a third input to the circuit described. This third input may be used to classify the pulses according to some externally applied criterion, such as amplitude discrimination and time coincidence. (atuh)

3329 A MOUSSA-BELLICARD TYPE IRON-FREE DOUBLE-FOCUSING BETA-RAY SPECTROMETER. Q. L. Baird, J. C. Nall, S. K. Haynes, and J. H. Hamilton (Vanderbilt Univ., Nashville). Nuclear Instr. & Methods, 16: 275-83(July 1962). (In English)

To achieve high resolution, high precision and good reliability at low electron energies, an iron-free, $\pi\sqrt{2}$ double focusing spectrometer has been constructed. The coil arrangement to produce the necessary $B/r^{\frac{1}{2}}$ field is similar to that of Moussa and Bellicard. Helmholtz type coils are used to compensate the earth's field. The current supply for the spectrometer is a 120-V d-c generator with a negative feedback system for reduction of noise. The current is controlled by a double, rotating coil system; one coil is in the spectrometer field and the other is in a permanent magnet field. An amplified a-c error signal is detected for control of the generator output. An accuracy of about 1 part in 10^4 is obtained in current regulation with the present control circuit. The resolution has been varied from about 0.1% to about 1% depending on the transmission desired. For particle detection, the instrument uses a continuous flow Geiger or proportional counter with very thin organic film windows. A special source holder permits studies of angular distributions of photoelectrons from converters. With an improved cooling system for the coils, the spectrometer may be used to measure energies up to 2.0 Mev. The present range of continuous operation is from 0.5 kev to about 1.3 Mev. (auth)

3330 ON THE DESIGN OF A SILICON JUNCTION RADIATION DETECTOR MADE BY ION DRIFT. P. E. Gibbons (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Instr. & Methods, 16: 284-6(July 1962). (AERE-R-3999). (In English)

A brief review is given of the present art in the production of thick depletion layers by lithium ion drift. The undesirable features of the existing devices are discussed and a design is proposed that may give a more satisfactory performance. (auth)

3331 PHOTOGRAPHY MEASURES SLOW-NEUTRON FLUXES. Hsian-shi Tsai, Siu-chung Ho, and K. H. Sun (National Tsing Hua Univ., Taiwan, China). Nucleonics, 20: No. 7, 60-1(July 1962).

Slow-neutron flux distributions in a spherical water-filled container are measured by stacks of photographic film and HBO_2-ZnS(Ag) neutron-detecting scintillator. The flux is determined by analysis of the optical density of the distributions in the film. A Pu-Be source is used at the center of the sphere. (T.F.H.)

3332 FOUR SLOW-NEUTRON CONVERTERS. Fa-yueh Wu, Tzu-Szu Kuo, and K. H. Sun (National Tsing Hua Univ., Taiwan, China). Nucleonics, 20: No. 7, 61 (July 1962).

The efficiencies with which Dy, Sm_2O_3, Gd_2O_3, Rh, and a B-containing ZnS(Ag) phosphor absorb slow neutrons and emit charged particles are measured. These materials are placed in contact with photographic film, and the charged particles produced by slow-neutron absorption are detected by measurements of the optical density of the film. The performance of these materials as neutron "converters" in neutron-counter applications is described and compared. (T.F.H.)

3333 MEASURING NEUTRON DOSE RATES. John A. Dennis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucleonics, 20: No. 11, 76-9(Nov. 1962).

Techniques and equipment for measuring neutron dose rates in the slow, intermediate, fast, and very high energy ranges are reviewed. The reaction $B^{10}(n,\alpha)Li^7$ is normally used to detect slow neutrons. Only one monitor was developed for intermediate energies (0.1 ev to 100 kev); it consists of a wax sphere surrounding a boron scintillator. Most fast-neutron monitors make use of proton-recoil effects. The problem of monitoring very high energy neutrons is discussed. No wide energy-range dose-rate meter has been developed yet. (D.L.C.)

3334 NEW DETECTOR FOR THE VACUUM ULTRAVIOLET. R. Lincke and T. D. Wilkerson (Univ. of Maryland, College Park). Rev. Sci. Instr., 33: 911-13(Sept. 1962).

A new method is described for detecting vacuum uv radiation. This radiation is converted to visible light in two steps, the first being creation of photoelectrons at a high voltage cathode, the second consisting of stopping these electrons in a scintillator at ground potential. The visible scintillations are detected with a standard photomultiplier. The system has been compared with a sodium salicylate detector, using a vacuum uv monochromator and a steady light source. Spectral lines between 500 and 1300 Å have readily been recorded. Compared to other systems, the new detector offers a number of advantages which are discussed. Preliminary results for pulsed light sources indicate that the method is also useful for studying phenomena whose time scales are of the order of 1 μsec. (auth)

3335 ELECTRON SHOWERS IN A LEAD PLATE SPARK CHAMBER. James W. Cronin, Eugene Engels, Manfred Pyka, and Richard Roth (Princeton Univ., N. J.). Rev. Sci. Instr., 33: 946-7(Sept. 1962).

A spark chamber, containing 40 Pb plates of one-third radiation length each, was exposed to electron beams of energy 85 to 750 Mev. The total number of sparks in the showers and their distribution is measured. For electron energies up to 200 Mev the results agree well with Wilson's Monte Carlo calculations. Above 200 Mev poor multiple track efficiency destroys the agreement. It is concluded that such a spark chamber is a good detector for electrons, and with further development could serve as a spectrometer. (auth)

3336 EFFECT OF PHOTOCATHODE-TO-FIRST DYNODE VOLTAGE ON PHOTOMULTIPLIER NOISE PULSES. R. Pagano, C. J. S. Damerell, and R. D. Cherry (Univ. of Cape Town). Rev. Sci. Instr., 33: 955-6(Sept. 1962).

Attention is drawn to a simple method of improving the signal-to-noise performance ratio of photomultiplier tubes used in scintillation counting. Representative results are presented and the underlying physical principles are discussed briefly. (auth)

3337 DETECTION OF 10- TO 100-kev IONS BY NUCLEAR TRACK PLATES. W. D. Davis (Knolls Atomic Power Lab., Schenectady, N. Y.). Rev. Sci. Instr., 33: 963-4(Sept. 1962).

The efficiency of 10- to 100-kev ions of He, Ne, and Ar in producing developed grains in nuclear track plates was determined by counting the individual grains. This efficiency is compared with the estimated range of the ions in the emulsion. (auth)

3338 AIR ALPHA PROPORTIONAL COUNTER INSENSITIVE TO ATMOSPHERIC HUMIDITY. A. M. R. Ferrari and C. J. Borkowski (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 33: 1047-50(Oct. 1962).

A conventional alpha proportional counter which uses air as the counter gas is sensitive to high relative humidity and generates spurious pulses that cannot be distinguished from actual alpha pulses. It was found possible to operate such a counter satisfactorily at high relative humidity by passing a small current (~15 ma) through the center wire. In this manner the center wire is heated and the relative humidity of the surrounding sheath of air is reduced sufficiently so that operation of the counter at high relative humidity is comparable to operation with dry air. Two different mechanisms are proposed for the formation of spurious pulses in such a counter at high relative humidity. (auth)

3339 PHOTOELECTRIC TRIGGERING OF FLASH PHOTOGRAPHY OF A LOW PRESSURE HELIUM CLOUD CHAMBER. David E. Frederick and J. H. Smith (Univ. of Illinois, Urbana). Rev. Sci. Instr., 33: 1100-2(Oct. 1962).

A photoelectric detector system was constructed which triggers a photographic flash lamp whenever a random, heavily ionizing event appears in a low-pressure helium diffusion cloud chamber. A 83 to 93% event detection efficiency for alpha-particle recoils of at least 1.8 Mev kinetic energy occurring in a 10-in. chamber was obtained by reflecting constant-intensity light from the vapor condensation along the path of a charged particle recoil into a light pipe system arranged so that five electron multiplier phototubes each viewed about one-fifth the chamber area. The equipment and operation are described and comments are made on the detection efficiency. (auth)

3340 RUBBER SOLLER SLIT COLLIMATORS FOR NEUTRON SPECTROMETRY. G. Caglioti and F. Farfaletti Casali (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). Rev. Sci. Instr., 33: 1103-5(Oct. 1962).

The design of rubber Soller slit collimators suitable for work in neutron spectrometry is illustrated. Experimental tests performed on the collimators proved the rubber lamellae to be very effective as collimating material. The performance of these collimators is that to be expected on the basis of the "Gaussian approximation" applied to the attenuation of a neutron beam proceeding through the typical elements of a crystal spectrometer. The simplicity of construction and the performance of these collimators recommend their use in the field of neutron spectrometry. (auth)

3341 DEVICE FOR GAS SCINTILLATORS, STABLE AS A FUNCTION OF TIME. Jean L. Teyssier, Daniel L. Blanc, and Alain A. Godeau (Nuclear Physics Center, Faculty of Science, Toulouse). Rev. Sci. Instr., 33: 1128-9 (Oct. 1962).

A scintillation chamber for filling with scintillating gases is designed which gives stable pulse heights. Quaterphenyl, used to shift the wavelength of the uv from the gas to longer wavelengths, is deposited on the outside wall of the quartz window, adjacent to the photomultiplier. The inside walls of the chamber are covered with magnesium oxide. After filling, the pulse heights decreased 0.6%/hr at 20°C, and after 60 hr, the diminution was only 0.2%/hr. (D.L.C.)

3342 $CaSO_4$(Mn) THERMOLUMINESCENCE DOSIMETERS FOR SMALL DOSES OF GAMMA RADIATION. Bengt Bjaerngard (Aktiebolaget Atomenergi, Studsvik, Sweden). Rev. Sci. Instr., 33: 1129(Oct. 1962).

The thermoluminescence dosimeter offers a cheap means of measuring gamma doses as small as 50 μr. The $CaSO_4$(Mn) is prepared according to Watanabe, and the phosphor powder, mixed with silicon resin, is painted on a strip of Kanthal. For the read-out, the dosimeter is heated by a-c through the Kanthal; the read-out temperature should be kept as low as possible. Random errors are discussed. (D.L.C.)

3343 SHORT DECAY TIME SCINTILLATOR SOLUTES. Milton Furst (New York Univ., New York), Arthur Greenberg, Hartmut Kallmann, and Herman O. Wirth. Rev. Sci. Instr., 33: 1131-2(Oct. 1962).

A number of recently synthesized substituted p-oligophenylenes have excellent scintillation properties, including shorter decay times with high pulse heights. The fluorescence properties of four substituted p-oligophenylenes in o-xylene are described; their decay times range from 1.2×10^{-9} to 2.6×10^{-9} sec. (D.L.C.)

3344 SIMPLE WAY OF USING A MULTIDETECTOR ARRAY. E. A. Wolicki and A. R. Knudson (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr., 33: 1132-3(Oct. 1962).

An arrangement for processing information from an array of solid-state detectors is described in which signal amplitude is used to identify the detector registering an event. In the arrangement, series resistors are used to attenuate the signal from each detector relative to the detector preceding it in the array. The effects of the number of detectors and the energy interval on the resolution are discussed. (D.L.C.)

3345 THE MEASUREMENT OF GAMMA DOSE WITH SILICON JUNCTION COUNTERS. A. R. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). IRE (Inst. Radio Engrs.), Trans. Nucl. Sci., NS-9: No. 5, 17-22(Nov. 1962).

Measurements were made on three types of silicon junction counters to assess their application in gamma ray dosimetry. These measurements are presented and it is concluded that each of the three types (high resistivity and guard-ring p-n junction counters and lithium drift counters) is suitable. Their limitations and means of application are also discussed. (auth)

3346 SPARK CHAMBER FOR ELECTRONIC INFORMATION RETRIEVAL. [PART] II. Michael J. Neumann and Herrick Sherrard (Univ. of Chicago). IRE (Inst. Radio Engrs.), Trans. Nucl. Sci., NS-9: No. 5, 51-4(Nov. 1962).

Experiments on a wire plate spark chamber were performed which showed that ion diffusion or photoionization, rather than electromagnetic coupling between adjacent wires, was the cause of signal spread. It was found that the spread could be reduced by shortening the duration of the spark. The narrowest signal was obtained when the pulse on the grid of the hard tube was set at a length slightly shorter than the delay between the voltage rise on the chamber and the breakdown of the spark. (D.L.C.)

3347 RADIATION DOSIMETER MADE OF HETEROGENEOUS GLASS. Pierre Georges Le Clerc (to Compagnie de Saint-Gobain). German Patent DAS 1,130,529. "Priority date Sept. 5, 1958 France."

A radiation dosimeter for measuring neutron fluxes is described. It consists of a single lamella of heterogeneous glass. One of the two opposite surfaces of this lamella is treated chemically in order to change the composition of the glass to a certain depth. With this chemical treatment the concentration of a neutron-absorbing element is changed. For example, a borosilicate glass can be used from which the boron is removed by treating it with sulfuric acid. If after this treatment the lamella is exposed to a flux of slow neutrons the volume of that part of the lamella from which no boron had been removed changes more than the other. As a result of the exposure the lamella bends and the curvature can be measured. Special details of construction are described. (H.K.)

3348 RADIATION DETECTION DEVICE. Robert Walter Reich. U. S. Patent 3,061,724. Oct. 30, 1962.

A simple radiation detector is described consisting of a housing containing a phosphor that emits light when subjected to radiation. Circuitry is described for providing a readily detectable indication of the presence of radiation. (R.J.S.)

3349 GAMMA INSTRUMENT CALIBRATION. Elmo J. Di Ianni and Fred C. Riggin. U. S. Patent 3,064,130. Nov. 13, 1962.

This invention relates to calibration of instruments for measuring intensity of gamma radiation, particularly those capable of measuring intense gamma radiation. The invention is applicable to instruments having sensitive elements that are responsible to beta as well as to gamma radiation. (R.J.S.)

ISOTOPE SEPARATION

Refer also to abstracts 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 2681, 2682, 2683, 2684, 2685, 2686, 2687, 2688, 2689, 2690, 2692, 2693, 2694, 2695, 2696, and 2697.

3350 (CEA-tr-X-468) SEPARATION DU DEUTERIUM, DE L'HYDROGENE PARA ET DE L'HYDROGENE ORTHO PAR CHROMATOGRAPHIE GAZEUSE. (Separation of Deuterium, Para-, and Ortho-Hydrogen by Gas Chromatography). [Takao] Kwan. Translated into French from Kagaku to Kōgyō (Tokyo), 14: 723-9(Aug. 1961). 26p.

The theoretical and experimental results on the gas chromatographic separation of deuterium, p-hydrogen, and o-hydrogen are reviewed. The topics discussed are the separating effect per adsorption-desorption cycle for hydrogen and deuterium, separation coefficient per adsorption and retention time, gas chromatography of deuterium and of p- and o-hydrogen, separation coefficient per adsorption in the gas chromatographic process, rotational motion of H_2 molecules in the adsorbed state, and separation or concentration of deuterium as well as of p-H_2 and o-H_2. (J.S.R.)

3351 SEPARATION OF POTASSIUM ISOTOPES BY ION EXCHANGE ELECTROMIGRATION. Isao Aoyama, Kenji Ishida, Chiyo Aoyama, Shuzo Tamura, Nozomu Morito, Ichiro Omura, Noboru Saito, and Kakuki Motoyama. Nippon Genshiryoku Gakkaishi, 4: 700-2(Oct. 1962). (In Japanese)

Ion-exchange-electromigration has been investigated as a method for separating potassium isotopes, and in this case the heavier ion K^{41+} has concentrated on the cathode side. An experimental value 1.045 ± 0.001, for example, has been obtained as the total separation factor defined by $(K^{41}/K^{39})_{cathode.}/(K^{41}/K^{39})_{pre-exp.}$. The measurements of isotopic ratio, which is an important factor for isotope separation, have carefully been made by two kinds of mass spectrometer. (auth)

3352 RECTIFICATION AS A SPECIAL CASE OF THE THEORY OF ISOTOPE SEPARATION. M. Huber. Sulzer Tech. Rev. (Switz.), 44: No. 1, 29-35(1962). (In English)

If rectification is treated as a special case of the theory of isotope separation, the two most important facts that emerge are the following: provided that the boiling points of the single components are known, the data of the column required for a given separation can be approximately indicated at once; and it is possible to calculate the extent to which a column deviates from the ideal case with the aid of the concept of the "value of a quantity of material" as introduced by Cohen. (auth)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 3539, 3818, 4053, and 4335.

3353 (ANL-6319(Rev.)) ENGINEERING APPLICATIONS OF ANALOG COMPUTERS. Lawrence T. Bryant, Marion J. Janicke, Louis C. Just, and Alan L. Winiecki (Argonne National Lab., Ill.). Revised Oct. 1962. Contract W-31-109-eng-38. 51p.

Six experiments from the fields of reactor engineering, heat transfer, and dynamics are presented to illustrate the engineering applications of analog computers. The steps required for producing the analog solution are shown, as well as complete information for duplicating the solution. Graphical results are provided. The experiments include: deceleration of a reactor control rod, pressure variations through a packed bed, reactor kinetics over many decades with thermal feedback, a vibrating system with two degrees of freedom, temperature distribution in a radiating fin, temperature distribution in an infinite slab considering variable thermal properties, and iodine–xenon buildup in a reactor. (M.C.G.)

3354 (KAPL-M-CHR-6) STOCHASTIC MODELS FOR HETEROGENEOUS MATERIALS. I. (LARGE SCALE INHOMOGENEITIES AND NEUTRON TRANSMISSION). Charles H. Randall (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 1962. Contract W-31-109-eng-52. 79p.

The performance of a heterogeneous material (or mixture), in general, critically depends on its microstructure. In order to evaluate such sensitivity with any degree of precision it is necessary to construct a mathematical model (or characterization) to describe the structure, and to relate it to the physical processes of interest. A simple example of such a model was described in KAPL-M-CHR-4. It, however, neglected small scale (less than particle dimension) statistics, and large scale (greater than particle dimension) inhomogeneities. The cell model described in KAPL-M-CHR-4 is extended to include the effects of large scale inhomogeneities for a large class of structures. The relations that exist between the structures described by the model and the phase intercept (volumetric, areal, and lineal), and neutron transmission processes are analyzed in detail. Numerical examples are presented to illustrate the results. (auth)

3355 (KAPL-M-MCR-2) BERRY — LINEAR SIMULTANEOUS EQUATION SOLUTION PROGRAM. Mary C. Ray (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 17, 1962. Contract W-31-109-eng-52. 17p.

BERRY is a program to solve a maximum of 150 linear simultaneous equations with a maximum of 10 sets of constants. Only the non-zero elements in the coefficient matrix need to be loaded because memory is cleared to zero before the input is read. The coefficient matrix and constant vectors are reduced to upper triangular form and the dependent variables are solved for by back substitution. (auth)

3356 (KAPL-M-WBJ-1) ENTH2 — A PROGRAM TO FIT FUNCTIONS OF ONE VARIABLE. W. B. Jordan (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 18, 1962. Contract W-31-109-eng-52. 26p.

ENTH2 is a digital computer program to find algebraic fits to specified data. The fits are of the type Polynomial + A/(D + X), and polynomials alone. Substantial flexibility is provided, such as: fits of any order up to the tenth; fits by different formulas over various ranges of the independent variable; variability of the factor D to improve the fit at one end of the range; and a calculation of errors at points outside the range fitted. The error in the fit is printed at each data point. (auth)

3357 (MSUCP-8) MISTIC PROGRAM FOR COMPUTATION OF THE MAGNETIC FIELD OF A CIRCULAR CURRENT. B. T. Smith (Michigan State Univ., East Lansing). Nov. 1960. Contract AT(11-1)-872. 36p.

Mathematical expressions for the magnitude of the magnetic field owing to a circular current are derived. The difficulty of evaluating elliptic integrals of modulus near 1 is obviated by successive applications of Landen's Transformation, resulting in expressions readily calculable by computers. The expressions for complete elliptic integrals of the first and second kinds are programmed, with explanations of order pairs. Directions for change of parameters are included. Programs for the magnitudes of the components of the magnetic field parallel and perpendicular to the axis are presented, with explanations as to scaling and use as a subroutine. (auth)

3358 (ORNL-3318) COMPUTER PROGRAMS USING ZONAL HARMONICS FOR MAGNETIC PROPERTIES OF CURRENT SYSTEMS WITH SPECIAL REFERENCE TO THE IBM 7090. M. W. Garrett (Oak Ridge National Lab., Tenn.). Dec. 4, 1962. Contract W-7405-eng-26. 46p.

The magnetic vector and scalar potentials, magnetic field components and their derivatives, and flux linkage for single current systems, and the mutual inductance, forces and torques between two such systems, whose axes are coplanar but not necessarily coincident are discussed. Each system may include a combination of coaxial loops, cylindrical or plane annular current sheets, and cylindrical coils of rectangular section. Working equations are listed, following an outline of theory. A discussion of errors and of means for reducing them leads to specific suggestions for use of the method with any programmed computer. An existing comprehensive program for the IBM 7090 is described in detail. The rate of convergence of the harmonic series depends on the ratio R of the polar radius of the field point to that of the current discontinuity nearest the origin. In some cases the precision reaches 1000 parts per million even at R = 0.95, improving to 1 or 2 parts at R = 0.80. Since the origin is arbitrary, the practical range of the method often includes the whole space that is accessible to experiment. For very close approach to the windings one must resort to elliptic integral methods or their equivalent. Alternative programs that were previously used are compared with the method of zonal harmonics, but they are slower by more than a factor of 10 when large numbers of field calculations must be made on a complex current system. One example is the problem of following individual ions through paths in the order of 100 turns in a field that is generated by 20 coaxial thick coils; available competing methods would have required too much computer time. The zonal harmonic method also has superior flexibility in attacking a wide range of problems. This is especially true for the calculation of rates of change, with respect to coordinates of the field or of the generating system, and for problems in which some property of a system must be not only calculated, but also adjusted to meet a specification. (auth)

3359 (PPAD-473E) TRANSFORMATIONS OF TWO-DIMENSIONAL DATA. T. Darrah Thomas (Princeton

Univ., N. J. Frick Chemical Lab. and Brookhaven National Lab., Upton, N. Y.) and Walter M. Gibson (Bell Telephone Labs., Inc., Murray Hill, N. J.). Oct. 18, 1962. Contract AT(30-1)-2137. 25p.

The problems arising when a frequency distribution that was measured as a function of two variables must be transformed into a distribution as a function of two variables that are different from but functionally related to the original ones are considered. The original grid, or matrix, in which the data were collected does not coincide with the grid representing the transformed data. The question, therefore, arises of how the number of recorded events constituting an element of the original matrix is to be apportioned among the elements of the transformed matrix. It is possible for fluctuations, not present in the original data, to appear in the transformed data if this problem is not handled properly. Several methods of handling this problem are discussed. Results obtained using some of them are presented. Their relative merits are considered. (auth)

3360 (SCR-314) COMPUTER ANALYSIS OF GAGE DATA. J. D. Gibson (Sandia Corp., Albuquerque, N. Mex.). Nov. 1962. Contract [AT(29-1)-789]. 13p.

Computer analysis is used to eliminate certain types of data bias, thereby improving gaging accuracy. Although the examples are taken from the field of contour measurement, the concepts apply to all branches of engineering metrology. A brief review of the elements of contour measuring is included. (auth)

3361 (SCTM-71-61(54)) A FORTRAN II SUBROUTINE SYSTEM TO PERFORM VARIOUS OPERATIONS ON A TIME SERIES USING THE IBM-704 DIGITAL COMPUTER. D. A. Young (Sandia Corp., Albuquerque, N. Mex.). Feb. 20, 1961. Contract [AT(29-1)-789]. 58p.

A Fortran II subroutine system for the IBM-704 digital computer to perform various operations on a time series is described. These operations include filtering out high or low frequencies from a time series to an input format acceptable to a spectrum estimation and a Fourier analysis program, and plotting on the IBM off line printers. (auth)

3362 (UCRL-6919) A COMPUTER PROGRAM FOR CALCULATING ONE-DIMENSIONAL HYDRODYNAMIC FLOW: KO CODE. Mark Wilkins, John French, and R. Giroux (California. Univ., Livermore. Lawrence Radiation Lab.). July 2, 1962. Contract W-7405-eng-48. 22p.

A computer program is described for the solution of shock, detonation, and spall problems for one-dimensional linear, cylindrical, or spherical hydrodynamic flow. The Flume option is used for calculating flow through arbitrary cross sections. (R.J.S.)

3363 (WAPD-T-1211) ON A NUMERICAL APPROXIMATION TO THE SOLUTION OF PARABOLIC EQUATIONS IN ONE SPACE VARIABLE (thesis). John P. Dorsey (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Sept. 1962. Contract AT(11-1)-Gen-14. 35p.

In various studies concerning solution of the heat equation, the methods used impose simultaneously a discrete mesh both in space and time, thus giving rise to questions of stability. Results of a study are presented in which only a discrete spatial mesh is imposed on a general parabolic equation in one space variable, and properties of a general class of ordinary matrix differential equations are examined. A particular higher order approximation based on these studies is given along with estimates of error likely in the use of this higher-order method. (J.R.D.)

3364 (WAPD-T-1531) A MEAN SQUARE DISCRETIZATION ERROR ESTIMATE. R. B. Kellogg (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1962. Contract AT(11-1)-Gen-14. 4p.

The mathematics of a method for estimating mean square discretization error are explained. (R.J.S.)

3365 GENERALIZED CUMULANT EXPANSION METHOD. Ryogo Kubo (Tokyo Univ.). J. Phys. Soc. Japan, 17: 1100-20(July 1962). (In English)

The moment generating function of a set of stochastic variables defines the cumulants or the semi-invariants and the cumulant function. It is possible, simply by formal properties of exponential functions, to generalize to a great extent the concepts of cumulants and cumulant function. The stochastic variables to be considered need not be ordinary c-numbers but they may be q-numbers such as used in quantum mechanics. The exponential function which defines a moment generating function may be any kind of generalized exponential, for example an ordered exponential with a certain prescription for ordering q-number variables. The definition of average may be greatly generalized as far as the condition is fulfilled that the average of unity is unity. After statements of a few basic theorems these generalizations are discussed here with certain examples of application. This generalized cumulant expansion provides us with a point of view from which many existent methods in quantum mechanics and statistical mechanics can be unified. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstracts 2751, 3695, 3713, 3723, 3728, 4230, and 4233.

3366 (ACNP-62550) EXTRUDED CERAMIC NUCLEAR FUEL DEVELOPMENT PROGRAM. Final Report, Phase II. (Allis-Chalmers Mfg. Co. Nuclear Power Dept., Washington, D. C.). June 15, 1962. Contract AT (11-1)-767. 44p.

Full-scale production of urania rods by extrusion is feasible, and extruded rods possess a number of advantages over urania in the form of compacted and fired pellets. Although work with enriched urania encountered certain difficulties, they are believed to be the result of avoidable variations in the properties of the starting material, and not inherent in the process or in enriched urania. The basis for comparing the cost of extruded fuels with the cost of pelletized nuclear fuel is presented. (R.J.S.)

3367 (AD-275092) TITANIUM SHEET ROLLING PROGRAM FOR Ti-8Al-1Mo-1V, Ti-5Al-5Sn-5Zr, AND Ti-7Al-12Zr. Summary Report. July 1, 1959-August 31, 1961. D. L. Day and H. D. Kessler (Titanium Metals Corp. of America, Toronto, Ohio). Dec. 15, 1961. Contract NOas 59-6227-c. 203p.

The process development for 3 advanced weldable Ti-base sheet alloys possessing improved elevated-temperature properties, Ti-8Al-1Mo-1V, Ti-5Al-5Sn-5Zr, and Ti-7Al-12Zr is summarized. The more important properties of each composition are discussed. Optimum procedures and conditions were established by processing several sheets from one ingot of each composition and evaluating the effects of various rolling and annealing temperatures on mechanical properties. A comprehensive evaluation of the properties of each composition showed that Ti-8Al-1Mo-1V is a higher strength alloy (130-Ksi minimum yield strength) with higher elastic modulus and lower ductility than either Ti-5Al-5Sn-5Zr (115-Ksi typical yield strength) or Ti-7Al-12Zr (125-Ksi typical yield strength) at temperatures through 800°F, but only minor differences in strength exist at 1000°F between the two higher strength materials, Ti-8Al-1Mo-1V and Ti-7Al-12Zr. Sub-zero temperature (to -320°F) notch properties of Ti-5Al-5Sn-5Zr are superior to those of Ti-8Al-1Mo-1V and Ti-7Al-12Zr, although the latter two are not considered to be especially notch sensitive. (auth)

3368 (AD-275571) INVESTIGATION OF REFRACTORY COMPOUNDS AS THERMIONIC EMITTERS. Final Report. Robert Steinitz and Leonard Berenbaum (General Telephone and Electronics Labs. Inc., Bayside, N. Y.). Apr. 30, 1962. Contract NOnr 3463(00). 83p. (TR 62-10.4)

Zirconium carbide thermionic emitters of high purity were prepared; however, high-temperature behavior in the diode was unstable. Measurements were made of the thermionic emission from polycrystalline tungsten to evaluate test diode performance. (R.J.S.)

3369 (AD-276084) RESEARCH AND DEVELOPMENT OF YTTRIUM IRON GARNET SINGLE CRYSTALS. Interim Engineering Report No. 1, July 1, 1961-December 30, 1961. (Texas Instruments, Inc., Dallas). Mar. 15, 1962. Contract NObsr-87241. 32p.

Yttrium iron garnet (YIG) single crystals $\frac{1}{4}$ to $\frac{3}{8}$ in. in dia. with a dielectric constant of about 10 and 0.002 dissipation factor have been produced by the floating zone technique. Ferrimagnetic resonance line-widths of less than 2 Oe were obtained from polished test spheres. Thermal cracking remains a major problem in growing YIG crystals by the floating zone method. A calcia-stabilized ZrO_2 susceptor was placed on a $MoSi_2$ auxiliary susceptor to decrease the thermal gradient just below the molten zone; however, the resultant decrease was insufficient to eliminate thermal cracks. Various arrangements and combinations of work coil, susceptor, auxiliary susceptor, and auxiliary resistance heater were used to give a temperature profile along the axis of the zoned YIG that would prevent formation of thermal cracks. Although the amount of cracking was reduced, it was not completely eliminated. (auth)

3370 (AD-276381) ARMY/NAVY INSTRUMENTATION PROGRAM. PART III a. APPENDIX: A SELECTION OF PHYSICAL EFFECTS AND THEIR DESCRIPTION. Summary Report, 1961. George Raabe, comp. (Servomechanisms, Inc., Goleta, Calif.). Contract Nonr-1076. 136p. (SMIR-62-5)

Physical effects in materials are described. Those effects covered include: acousto-electric, adiabatic demagnetization, antiferroelectricity, antiferromagnetism and ferrimagnetism, Barnett, barrier layer rectification, Cherenkov radiation, Compton, Corbino, Cotlon-Mouton, cyclotron resonance or diamagnetic resonance, defect optical absorption, De Haas-Van Alphen, Dember, dispersion and normal, Einstein-de Haas, electrets, electroluminescence, electron spin resonance, electrostriction, Ettingshausen, Faraday magneto-optic, ferroelectricity, ferromagnetism, polarized fluorescence, gyromagnetic, Hall, Kerr electro-optical, Kerr magneto-optical, laser, luminescence, magnetoresistance, magnetostriction, Meissner, Mossbauer, Nernst and Ettingshausen, nuclear magnetic resonance, nuclear quadrupole resonance, nuclear resonance, acoustic absorption, optical activity, Overhauser, Peltier, photoconductivity, photodielectric, photoelasticity, photoelectric emission, photoelectromagnetic, photovoltaic, piezoelectricity, plasma resonance, plasmon radiation, pleochroism, pyroelectricity, quantized magnetic flux in superconductors, recombination radiation, Righi-Leduc, Seebeck, space-charge current, spin wave and ferromagnetic resonance, Stark, Suhl, superconductivity, thermoelectricity, Thompson, tunnel, Voigt, and Zeeman. (M.C.G.)

3371 (AERE-M/M-164) METHODS OF DRYING BERYLLIUM POWDER. R. G. Bellamy (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1957. 10p.

Methods of drying Be powder are reviewed. Significant oxidation by moisture occurs when wet Be powder is dried by heating in air. The degree of oxidation is dependent on the drying temperature and not on the drying time. If dry Be powder of low oxygen content is required, vacuum drying at a low temperature is recommended. Some features of this process based on U powder experience are described. (auth)

3372 (AFCRL-62-315) THE PREPARATION OF HIGH PURITY RARE EARTH METALS. Scientific Report No. 2, January 1, 1961 to January 31, 1962. (Research Chemicals. Div. of Nuclear Corp. of America, Phoenix,

Ariz.). Apr. 1962. Contract AF19(604)-7491. 97p. (RC-196; AD-276748)

Ultra-high purity rare earth metals, Pr, Eu, Gd, and Lu with total metallic impurities of less than 10 ppm have been made. Methods of separation, reduction and purification were: ion exchange, mercury amalgamate oxidation-reduction, dry fluoride preparation, metallothermic reduction, and vacuum distillation. Spectrographic methods were improved and refined to obtain greater sensitivity. Gas chromatography was investigated as an analytical tool for determination of impurities in rare earth organometallics. (auth)

3373 (ARL-62-416) EFFECTS OF LONG TERM VACUUM ON COMMERCIAL SILICON RADIATION DETECTORS. W. L. Weiss and E. M. Whatley (Oak Ridge Technical Enterprises Corp., Tenn.). May 26, 1962. Contract AF33(616)-8397. 137p.

A graphical representation describes the effects of long-term vacuum ($\sim 10^{-6}$ mm Hg for 6 mo) on commercially available Si radiation detectors of two types: surface barrier, which are manufactured from n-type single crystal Si and diffused junction, which are manufactured from p-type single crystal Si. Data include measurements of alpha resolution, dead layer or window thickness, RMS noise voltage, reverse leakage current and pulse height stability at rated voltage. A summary of radiation damage on semiconductor materials and devices is included. (auth)

3374 (ARL-230) ELECTRON CORRELATION IN METALS. Annual Summary Report No. 2, November 1, 1960–October 31, 1961. N. H. March and S. Sampanthar (Sheffield, England. Univ.). Contract AF61(052)-317. 24p. (AD-273793).

Results for the diagonal element of the second-order density matrix (pair function) and for the momentum distribution of an interacting electron gas are presented. In the low density limit, it is shown that, to a similar degree of approximation, the first-order density matrix and hence the momentum distribution may be obtained. In the high-density problem, the pair function has also been calculated using the Green's function approach. From the information available in these high and low density limits, the range of usefulness of the concept of the Fermi surface in an interacting electron gas is discussed. Also, results of variational calculations on the stability of Overhauser spin-density waves in metals are reported. It is concluded that such waves reduce the energy below the Hartree-Fock value only when the interaction becomes very strong, or equivalently when the density is very low. Some preliminary work on the correlation problem in a non-uniform electron gas is also briefly discussed. (auth)

3375 (ASD-TR-7-826(II)) TANTALUM ALLOY INGOT RELIABILITY AND SHEET ROLLING DEVELOPMENT PROGRAM. Quarterly Progress Report, [January 25, 1962–April 25, 1962]. Socrates S. Christopher (Wah Chang Corp., Albany, Ore.). Apr. 25, 1962. Contract AF33(657)-7015. 22p. (AD-276408)

Direct arc melting of a composite electrode of the Ta–30Nb–7.5V alloy was selected as the initial method of consolidation. The composite electrode approach was found to be unsuccessful because of Ta segregation which resulted from small pieces of Ta from the electrode falling into the molten pool. An arc remelt of the quartered ingots did not alleviate the segregation problem. A new approach to melting the alloy was selected which consists of a combination of electron-beam and arc melting. Electron-beam melting is used to consolidate a Ta–32.5Nb master alloy followed by arc melting in which the V addition is made. Three electron-beam melted Ta–32.5Nb ingots were melted. These ingots will be quartered and re-arc melted with the proper V addition to complete the Phase II portion of this program. (auth)

3376 (ASRCE-TM-62-7) BIBLIOGRAPHY OF SUPER-SONIC TRANSPORT CANDIDATE METALS. Don Ingels and George Young (Aeronautical Systems Div. Applications Lab., Wright-Patterson AFB, Ohio). Apr. 20, 1962. 160p.

A bibliography on metals considered for use in supersonic vehicles is presented. About 450 references with abstracts are included. (J.R.D.)

3377 (AWRE/LIB/BIB/6) URANIUM–MOLYBDENUM ALLOYS. Dorothy Beck (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Sept. 1962. 7p.

References to published articles and reports are listed which were obtained mainly from Nuclear Science Abstracts, Vol. 12 through 16, Reviews of Metal Literature, 1956 to 1960, and AWRE Library indexes. About 130 references are included. (J.R.D.)

3378 (BMI-1583(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JUNE 1962. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). July 1, 1962. Contract W-7405-eng-92. 82p.

Progress is reported on reactor materials and components, studies of fuels, general fuel-element development, preparation of UO_2 single crystals, radioisotope and radiation applications, materials development and evaluation, coated-particle fuel materials, corrosion studies of Fluoride Volatility Process, progress on USAEC/AECL cooperative program, fission-product deposition studies, radiation-effects study of candidate fuel materials for MGCR, gas-cooled reactor program, process development and evaluation of properties of F-48 niobium alloy, and gas pressure bonding of beryllium-clad elements. (M.C.G.)

3379 (BMI-1596(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING SEPTEMBER 1962. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1962. Contract W-7405-eng-92. 74p.

Progress is reported in the following areas: radiation effects on mechanical properties of Type 347 stainless steel; selection of bearing materials in molten Na; effect of B^{10} burnup in B-compound dispersions; development of Th–U fuels for thermal breeder reactors; development of Pu alloy fuels; fission product release from refractory fuels; effects of fabrication on radiation stability of UC; burnup effects on ceramic UO_2-CeO_2 and UO_2-ZrO_2 fuels; radiation effects on Mo–U alloys; fabrication of cermet fuel elements; gas-pressure bonding of ceramic fuel elements; gas-pressure bonding of metals; gamma radiation effects on polymers; sealed radiation source test parameters; creep properties of Zircaloy-2; thermal conductivity and electric conductivity of UO_2; evaluation of fuel particles of UO_2, UC, and UC_2; coating of UO_2 fuel particles with Al_2O_3, BeO, and MgO; coating fuel particles with pyrolytic carbon; graphite-matrix fuel studies; fission-gas release from coated-particle fuels during irradiation; radiation effects on coated-particle fuels; fission gas analysis; radiation effects on nonfissionable ceramics; rare gas fission product diffusion on fuel particles; coated fuel particle compatibility studies; compatibility of refractory oxides with reactor coolants; thermal conductivity of coated fuel particle specimens; commercial

availability and quality of coated fuel particles; radiation-induced strain in ceramics; corrosion resistance of metals and alloys; creep-rupture properties of sintered aluminum powder alloys; fission product deposition in out-of-pile loops; radiation stability of ceramic-matrix fuels; radiation stability of various materials, electronic components, and coatings; fabrication, properties, and phase studies of UO_2-ZrO_2 system; radiation effects on mechanical and microstructural properties of Hastelloy X cladding; radiation stability of Hastelloy X-clad UO_2-BeO compacts; properties and fabrication of F-48 niobium alloys; and joining of alloy foils. (R.J.S.)

3380 (ERR-FW-049) CURRENT INFORMATION ON THE REFRACTORY METALS. (Formerly FZM-1898 dated November 9, 1959). R. E. Johnson (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Dec. 23, 1960. 65p. ([AD-273624]).

Information contained in report FZM-1898 is presented in a revised form to incorporate the latest data available. Data on new alloys are also included. The information concerns about 10 metals and alloys. Elevated temperature and oxidation data are included along with fabrication and cost information. 84 references are included. (J.R.D.)

3381 (GEMP-17A) HIGH-TEMPERATURE MATERIALS PROGRAM, PROGRESS REPORT NO. 17, PART A. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Nov. 15, 1962. Contract AT(40-1)-2847. 53p.

A series of experiments designed to define the kinetics of barrier formation in the Fe-Cr-Al-Y-clad UO_2 fuel element system was initiated, using thin cladding with picture-frame specimens. The first series of specimens, hot-pressed for times up to 20 hours at 1000°C, showed no reaction between UO_2 and aluminum. Specimens containing $UO_2 + Cr_2O_3$ formed a continuous barrier of Al_2O_3 about 1.7 microns thick in 20 hours. Uranium monosulfide (US) used as a fuel in the Fe-Cr-Al-Y-clad chromium system remained stable when tested in massive die specimens at 1000 to 1200°C for 100 hours. This fuel also appeared stable in a Cr–50 US (by volume) compact sintered at 1500°C in hydrogen. Compatibility with several other refractory metals was demonstrated up to 2200°C. The oxidation rates were established for iridium to 2000°C, platinum to 1600°C, and palladium to 1300°C, in flowing air for times up to 1000 hours. This completes the stability study of unalloyed noble metals and indicated limited life for these metals in high-temperature fuel elements. Molybdenum stress-rupture testing was continued at 2200°C in hydrogen and argon. These tests indicated higher rupture strengths in argon but additional tests are required to confirm these data and identify the reasons for the observed increase. Additional stress-rupture tests of Ta–10W were made in hydrogen and argon at 2600°C; no significant differences in stress rupture strength were noted. Stress-rupture tests of electron-beam-welded Ta–10W showed that 100-percent joint efficiency can be attained. Creep mechanism analysis procedures of Ta–10W data indicated fairly good agreement with existing high-temperature creep theories, particularly in regard to the exponent on stress. Testing of specimens to determine the threshold of neutron-irradiation-induced changes in stress rupture properties was completed. The apparent threshold of the neutron-induced reduction in the 50-hour rupture life of René 41 specimens, irradiated and tested at about 650°C, lies between 10^{15} and 10^{16} nvt ($E_n \geq 1$ Mev). The René 41 test results indicate a response similar to the Hastelloy X data while the A-286 test results indicate that the threshold of irradiation-induced reduction in stress rupture properties is less than 10^{15} nvt ($E_n \geq 1$ Mev). Comparisons of control and irradiated Hastelloy X tensile specimen data indicate that neutron irradiation at temperatures from 540 to 870°C does not significantly change the tensile strength. Approximately 90 percent of the data derived from matching specimens show a definite increase in the yield strength caused by neutron irradiation. Ductility decreases with an increase in the irradiation temperature. The data from specimens irradiated at 870°C indicate a decrease in ductility with an increase in post-irradiation tensile test temperature. Irradiation and subsequent testing of Hastelloy X and René 41 specimens at 870°C continues to show an irradiation-induced reduction in the stress rupture strength. Both materials tested at this temperature exhibit a convergence of the control and irradiated data at the lower stress levels. Reheat treatment of the irradiated specimens prior to testing does not improve the irradiation-induced reduction in stress rupture strength. In addition, the reheat treatment appears to remove the tendency for the control and irradiated data to converge at the lower stress levels. Hardness studies on samples prepared for structure evaluations indicate that reactor ambient neutron-irradiation of the as-solutioned A-286 material increases the hardness. This increase is smaller as the solution temperature increases. Final hardness seems independent of the sequence of irradiation and aging after the solution treatment. Post-irradiation investigation of the ORF-2 fuel specimen-capsule assembly was continued. Visual and dimensional inspections, burn-up analysis, and evaluations of fission product retention were conducted. The condition of the fuel specimen was found to be satisfactory upon removal from the capsule. No distortion, cladding penetration, nor excessive oxidation were observed. About 9.74 percent of the U^{235} atoms were consumed during 876.5 hours at a fuel specimen temperature of 815°C. No significant release of fission products was observed during the test. (auth)

3382 (NMI-9522) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report to Aeronautical Systems Division, April 1, 1962–June 30, 1962. S. H. Gelles (Nuclear Metals, Inc., Concord, Mass.). Nov. 5, 1962. Contract AF33(616)-7065. 81p.

Progress is reported on the following studies of beryllium: transmission electron microscopy examination of brittle behavior, metallurgical factors in ductile-brittle transition, preparation and evaluation of fine-grained metal, recrystallization, grain growth, impurity and precipitate identification, preparation of high-purity metal, and powder metallurgy. (R.J.S.)

3383 (NUMEC-P-48) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Monthly Progress Letter for Month of August 1962. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Sept. 5, 1962. Contract AT(30-1)-2389. 4p.

Progress is reported on fabrication of reactor fuel elements containing (plutonium, uranium) dioxide pellets; outfitting of hot cell alpha boxes; characterization and sintering of (plutonium, uranium) dioxide powders; and preparation of plutonium dioxide, uranium dioxide, and (plutonium, uranium) dioxide. (R.J.S.)

3384 (NUMEC-P-102) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Progress Report, July 1 through September 30, 1962. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2389. 52p.

Characterization and sintering results indicate signifi-

cant differences between UO_2–35 wt % PuO_2 and the compositions containing lesser (<20 wt %) amounts of PuO_2. PuO_2 has now also been prepared by plutonium hydroxide precipitation. Sintering studies have shown that satisfactory density is readily attained with these PuO_2 materials. Development of analytical chemistry procedures required for support of the fuel cycle program is continuing. The x-ray emission procedure developed for the determination of plutonium and uranium is now being used on a routine basis. In preparation for post-irradiation analysis, analytical chemistry effort is being directed towards the development of plutonium and cesium separation procedures suitable for hot cell-alpha box techniques. For the short-term irradiation test program, the characterization as to density, open porosity, and closed porosity of sintered pellets has been continued. Pellets of each composition and density level have also been set aside as library samples and for x-ray diffraction and metallographic examination. The mechanical packing studies using spherical UO_2 particles have been extended to the use of small diameter tubes suitable for reactor fuel elements. Plasma torch spheroidization studies have been extended to the mixed oxide, UO_2–20 wt % PuO_2. It has been determined that fusion of this mixed oxide is more difficult than the pure PuO_2 investigated previously. The capsules for the short-term irradiation tests are now ready for final encapsulation, and samples of the fuel materials are undergoing complete pre-irradiation examination and evaluation. The final testing of the apparatus for the measurement of the thermal conductivity of poor thermal conductors at high temperature is almost completed. A study has been initiated to determine the compatibility of UO_2–PuO_2 mixtures with cladding, moderator, and fuel diluent materials. The reactor physics and economics study of the effect of ZrO_2 dilution of PuO_2–UO_2 fuels in near-thermal converter reactors has been completed. (R.J.S.)

3385 (TID-8212) USE OF DEPLETED URANIUM IN BEARING METALS AND LOW-ALLOY STEELS. Final Metallurgical Report, April 1, 1959 to June 30, 1962. (Bureau of Mines. Rolla Metallurgical Research Center, Mo.). 44p.

The use of depleted U as a constituent in antifriction alloys and as an alloying addition to steel was investigated. Casting methods were developed for binary and ternary Pb-, Sn-, and Cu-base alloys containing up to 33% U. The alloys were tested for hardness, compressive strength, wear resistance, and coefficient of friction; the test results were compared with known properties of commercial babbitts. A few of the experimental alloys were superior in some respects to commercial babbitt materials. A Sn–5% U alloy was tested for use in a railroad bearing. Uranium was added in amounts up to 1.5% to a medium-carbon 2% Ni steel. After melting and forging techniques were developed, the micro-structure of the steels was studied, and the material was tested for mechanical properties. No significant improvement in tensile strength, ductility, or hardenability of the steels could be attributed to the addition of U. Radiation surveys were made at each step in the melting and fabrication processes, and data are tabulated. (auth)

3386 (TID-14534) A VERSATILE CATHODIC ETCHER. John W. Ward (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 18p. (LADC-5133)

A cathodic etcher that can be used both for investigating some of the problems encountered in ion bombardment etching and for routinely preparing metallographic samples is described. Important features of this instrument include short pumpout times, vernier control of the vacuum and argon flow during etching, and a simple method of focusing the argon beam. A special technique allows plastic-mounted specimens to be etched. The effects of pressure and voltage on etching efficiency and the benefits that may be gained from using very low pressures in the etching chamber are discussed. (auth)

3387 (TID-17322) MATERIALS FOR HIGH TEMPERATURE NUCLEAR ENGINEERING APPLICATIONS. Summary Report No. 1, June 1, 1961 to June 1, 1962. J. D. Fleming, J. W. Johnson, Paul Boland, S. H. Bomar, and A. R. Colcord (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT(40-1)-2483. 68p.

Devitrification rates were determined in a high temperature x-ray diffraction unit using samples of fused silica slip cast in three types of plaster with two types of mold release. A system was designed to measure the porosity, bulk density, and theoretical density of porous fused silica specimens by air displacement. Estimation of a firing correction time for the silica proved possible using the porosity data. The use of this correction time permitted the properties of the dried cast silica to be correlated with the fired properties. The porosity and the modulus of rupture of slip cast fused silica were measured as a function of firing conditions. A study was made of the compressive strength of slip cast fused silica. Further statistical analyses of the firing procedure for silica tensile test rings showed that the data scatter was principally due to vertical temperature gradients in the furnace. Investigations were made of the influence of firing atmosphere on the properties of slip cast fused silica. The initial studies showed that steam had a striking effect on the fired strength and porosity as well as the expected effect on devitrification rate. The Kr-85 permeation system was completed and check runs were begun. Three replicate runs on a single sample indicated effective diffusivities with a maximum deviation of 3.5% from the average. Alumina casting slips were developed by wet and dry milling of Norton Type 38 Alundum. Studies were made of the influence of mold vibration and pressure application on the casting rate of the alumina slips. The apparent theoretical density of the U_3O_8 used in the studies of Al-U_3O_8 interactions was measured by air displacement and in a Beckman air pycnometer. The particle size of the U_3O_8 used in the pellets markedly influenced the thermet ignition characteristics. Studies were begun to elucidate the influence of aluminum content on the Al-U_3O_8 interactions. Electron beam microprobe analyses were made of fired composites containing 14.6 wt % aluminum. Several thermochemical calculations were made to indicate the maximum energy release to be expected from reacting Al-U_3O_8 composites. Several motion pictures and still photographs were made of igniting 14.6 wt % aluminum composites. Be-U_3O_8 compacts containing 7.9 wt % of –325 mesh beryllium were subjected to differential thermal analysis. (R.J.S.)

3388 (UCRL-6800) BeO STUDIES: SINTERING OF BERYLLIA POWDERS. Raymond Cooperstein (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 8, 1962. Contract W-7405-eng-48. 15p.

Beryllium oxide powders are under active consideration for nuclear, structural, and electronic applications. Fabrication results with commercial beryllia powders have indicated a need for improving the degree of reproducibility with respect to purity and sinterability. A discussion is presented on the results of studies to establish the opti-

mum conditions for producing shapes exhibiting high density and constant shrinkage reproducibly from beryllia powders prepared by thermal decomposition of high-purity beryllium compounds. (R.J.S.)

3389 (USBM-U-978) METALLURGICAL QUARTERLY PROGRESS REPORT NUMBER 16 FOR THE PERIOD OF JULY 1, 1962–SEPTEMBER 30, 1962. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 22p.

The possibility of producing rare earth alloys for reactor control uses is being investigated. Oxidation studies of erbium rich alloys revealed that small additions of Zr, Cr, V, Fe, Cu, Ni, Al, and Si have little effect. Phase studies of Hf–C, Hf–Ir, and Hf–V alloys are discussed. Sintering of Mo–Gd compacts improved density and tensile strength and had no effect on impact strength. Test results are included. Research on Th alloys revealed that addition of Ho increases tensile and yield strength, and oxidation resistance at 250°C while additions of Nd and Pr have the opposite effect. Alloys found suitable for joining Nb or its alloys are Nb–Ti–V compositions and Nb–V, and Nb–Cr–Al–Ti alloys. Research on melting is reported concerning thermodynamics of cold-molds, electron-beam melting, HfC electrodes, and skull casting U. (J.R.D.)

3390 (WADC-TR-53-373(Suppl.8)) A REVIEW OF THE AIR FORCE MATERIALS RESEARCH AND DEVELOPMENT PROGRAM. Junie J. Banks and Donna J. Tate (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). Nov. 1961. 204p. (AD-276709)

Basic and applied research in the materials area being conducted by the Metals and Ceramics, Nonmetallic Materials, Physics, Manufacturing Technology and Applications Laboratories of the Directorate of Materials and Processes is reported. (auth)

3391 (EURAEC-429) PLUTONIUM RECYCLING. Quarterly Report No. 5, April 1 to June 30, 1962. (France. Commissariat à l'Énergie Atomique, Paris). Work performed under United States–Euratom Joint Research and Development Program. Contract 037-60-12RDF. 12p. (A Translation).

Al_2O_3-UO_2 dispersions were prepared by crushing, mixing, pressing, and sintering at 1700°C in a hydrogen stream. Electrical resistivity measurements were made on UO_2 mono-crystals and on UO_2-PuO_2 sintered samples. Results are presented in graphs. (M.C.G.)

3392 (JPRS-16063) DUCTILE NIOBIUM PRODUCTION FROM ELECTROLYTIC POWDERS. V. M. Amosov. Translated from Izv. Vysshikh Uchebn. Zavedenii, 4: Tsvetn. Met., No. 4, 122-31(1962). 21p.

The preparation of high-purity niobium by the electrolysis of melted media is described. Niobium pentoxide mixed with either potassium fluorotantalate or some other complex fluoride and chlorides and fluorides of alkali metals gave good results. The preparation of ductile niobium was found to be possible only when very definite proportions of oxygen, carbon, and a number of other admixtures are present in the original powders. High-temperature processes for refining niobium in a vacuum are discussed. (M.C.G.)

3393 CONTRIBUTION TO A STUDY ON THE OBTENTION OF HIGH PURITY BERYLLIUM BY ELECTROREFINING FROM FUSED SALT BATHS. G. Boisde, M. Broc, G. Chauvin, H. Coriou, J. Hure, and P. Jarny (Centre d'Études Nucléaires, Saclay, France). J. Nucl. Mater., 6: 256-64(Aug. 1962). (In French)

By electrolytic refining at 400 to 500°C from molten baths containing a LiCl–KCl–$BeCl_2$ mixture, beryllium of high purity can be obtained. A study of this method of purification established the following characteristic features: 1) One can use the necessary anhydrous baths by dissolving $BeCl_2$ "in situ:" $BeCl_2$ is formed within the molten LiCl–KCl solvent itself by the chemical displacement reaction $Be + SnCl_2 \rightarrow BeCl_2 + Sn$. 2) Because impurities (notably iron) are concentrated in the immediate vicinity of the cathode, the technique used for washing the deposits has a pronounced influence on the purity of the refined metal. 3) According to the current density/potential plots, the great efficacy of this method of electrolytic refining appears to be due to a very fast-acting electrochemical system favorable to the elimination of impurities. (auth)

3394 XENON DIFFUSION IN URANIUM CARBIDE POWDER. Allan Auskern (Brookhaven National Lab., Upton, N. Y.) and Yasutaka Osawa. J. Nucl. Mater., 6: 334-5(Aug. 1962). (In English) (BNL-6012)

Results on Xe^{133} diffusion in irradiated UC are described for the first series of experiments on two UC powder preparations. The powders were irradiated for 0.5 hr in a thermal neutron flux of 10^{13} nv, and diffusion anneals were carried out at different temperatures. The xenon release data are treated assuming the release is diffusion controlled and the powders are perfect spheres of uniform size. The diffusion coefficients for the two powders are in good agreement, and a plot of their logarithms vs 1/T gives $D = 2.1 \times 10^{-5}$ exp (–85,100/RT) at 1000 to 1400°C. (D.L.C.)

3395 A REACTION OF DISLOCATIONS IN α URANIUM. J. Leteurtre (Centre d'Etudes Nucléaires, Saclay, France). J. Nucl. Mater., 6: 338-41(Aug. 1962). (In French)

Foils of α U containing twinned crystals are hardened under tension, and the interaction of the twinning plane (121) with the glide systems (010) [100] and (001) [100] is observed. The dislocations caused by this interaction are observed using an electron microscope. (T.F.H.)

3396 ELECTRON MICROSCOPE STUDY OF URANIUM CONTAINING KRYPTON. J. Leteurtre and G. Brebec (Centre d'Etudes Nucleaires, Saclay, France). J. Nucl. Mater., 6: 342-5(Aug. 1962). (In French)

Foils of U containing Kr are prepared by passing an electric discharge through Kr, using the U foils as electrodes. The foil temperature at the termination of the discharge is on the order of 300°C. The foils are examined under an electron microscope, and it is found that dislocation loops having diameters of 50 to 300 Å are formed, as well as twinning surfaces for which the plane is typically {130}. After annealing of the foils at 620°C for 24 hr, the Kr forms bubbles having diameters of 50 to 400 Å. Annealing also increases the crystallite size from about 1 to about 2 or 3 μ. (T.F.H.)

3397 LATER PLUTONIUM METALLURGICAL RESEARCH AT LOS ALAMOS. A. S. Coffinberry (Los Alamos Scientific Lab., N. Mex.). p.36-62 of "The Metal Plutonium." Chicago, University of Chicago, 1961. (LADC-3119)

Discussion is given on plutonium metallurgical research at Los Alamos including organizational changes and plutonium metallurgy during earlier postwar years, history of the plutonium physical metallurgy group, plutonium health hazards, and the new chemistry-metallurgy building. (P.C.H.)

3398 NUCLEAR GRAPHITE. R. E. Nightingale, ed. New York, Academic Press, 1962. 557p. $15.80.

Seventeen papers of a review nature are presented on various topics in graphite technology. They treat the manufacture, properties, radiation effects, and uses of graphite.

Bibliographies are included. Separate abstracts were prepared for all the papers. (D.L.C.)

3399 GRAPHITE IN THE NUCLEAR INDUSTRY. R. E. Nightingale (General Electric Co., Richland, Wash.). p.1-20 of "Nuclear Graphite." New York, Academic Press, 1962.

The use of graphite as moderator in the first atomic pile and anticipated problems of such use are described. Current applications and costs of nuclear graphite are discussed briefly. The graphite-moderated reactors constructed or planned over the world are tabulated with the moderator conditions. Finally, future applications of graphite as high-temperature materials are considered. (D.L.C.)

3400 MANUFACTURE. W. P. Eatherly and E. L. Piper (National Carbon Co., Parma, Ohio). p.21-51 of "Nuclear Graphite." New York, Academic Press, 1962.

The manufacture of electrographites for reactor use is discussed in detail, from the calcination of petroleum coke, extrusion, baking, to graphitization. The properties of the carbons at different stages are tabulated. Newer fabrication techniques are described briefly. (D.L.C.)

3401 MACHINING PRACTICE. C. A. Switzer, Jr. and L. H. Juel (Great Lakes Carbon Corp., Niagara Falls, N. Y.). p.53-65 of "Nuclear Graphite." New York, Academic Press, 1962.

General machining techniques for graphite are described, including finishes, tools, speeds and feeds, and dust collection. Special requirements for machining nuclear graphite are outlined. Equipment and methods are described for machining graphite for Hanford, Brookhaven, and United Kingdom Atomic Energy Authority. Cementing techniques for joining graphite to graphite are discussed in some detail. (D.L.C.)

3402 NUCLEAR PROPERTIES. P. F. Nichols and E. M. Woodruff (General Electric Co., Richland, Wash.). p.67-85 of "Nuclear Graphite." New York, Academic Press, 1962.

The nuclear requirements for moderator graphite (high density and purity) are outlined, and the basic concepts of moderator physics are discussed in some detail. Reactor and chemical methods for measuring the net effect of all impurities on the neutron absorption cross section are described, and some of the impurities that may increase the cross section of nuclear graphite are discussed. It is shown that chemical analysis is not always sufficient in estimating the absorption cross section of graphite. (D.L.C.)

3403 STRUCTURE. R. E. Nightingale (General Electric Co., Richland, Wash.). p.87-115 of "Nuclear Graphite." New York, Academic Press, 1962.

The nomenclature terms used in describing the structure of carbons are defined. The crystal structure of graphite and the forces within crystallites are described. The following structural properties of polycrystalline graphite are discussed: lattice dimensions, lattice distortions, crystallite size, pore structure, and grain structure. Structural changes during graphitization of carbons are described. (D.L.C.)

3404 PHYSICAL PROPERTIES. R. E. Nightingale (General Electric Co., Richland, Wash.), H. H. Yoshikawa, and H. H. W. Losty. p.117-94 of "Nuclear Graphite." New York, Academic Press, 1962.

The following properties of graphite are treated in detail: thermodynamic properties, thermal properties, electronic band structure, electronic properties, chemical properties, mechanical properties, density, surface properties, and permeability. (D.L.C.)

3405 THEORY OF RADIATION EFFECTS IN GRAPHITE. D. R. De Halas (General Electric Co., Richland, Wash.). p.195-238 of "Nuclear Graphite." New York, Academic Press, 1962.

The interaction of radiation with solids, which generally results in displacement of atoms, and production of further displacements by knock-on atoms are described. The creation of displacements in graphite by neutrons and the displacement rates in reactor graphite are discussed. The problem of reactor radiation dosage units in studies of irradiated graphite is considered. The nature of radioinduced defects and their annealing are described. (D.L.C.)

3406 IRRADIATION TECHNIQUES. D. E. Baker and J. M. Davidson (General Electric Co., Richland, Wash.). p.239-58 of "Nuclear Graphite." New York, Academic Press, 1962.

Equipment and methods are discussed for irradiation of graphite at low temperatures, room temperature, high temperatures, and under controlled atmospheres. Monitoring of reactor graphite moderators for dimensional and property changes is considered. Illustrative examples are drawn from Hanford and other reactors. (D.L.C.)

3407 RADIATION-INDUCED STRUCTURAL AND DIMENSIONAL CHANGES. R. E. Nightingale, H. H. Yoshikawa, and E. M. Woodruff (General Electric Co., Richland, Wash.). p.259-93 of "Nuclear Graphite." New York, Academic Press, 1962.

A detailed review of the radiation effects on the crystal structure of graphite is presented. The effects on surface area and pore size at different temperatures are discussed. Dimensional changes in nuclear and experimental graphite and moderator structures are discussed. (D.L.C.)

3408 RADIATION EFFECTS ON ELECTRICAL AND THERMAL PROPERTIES. R. E. Nightingale (General Electric Co., Richland, Wash.). p.295-312 of "Nuclear Graphite." New York, Academic Press, 1962.

A review is presented on the effects of reactor radiation on the properties of graphite. The properties treated are electrical resistance, magnetoresistance, Hall coefficient, thermoelectric power, magnetic properties, thermal conductivity, and specific heat. (D.L.C.)

3409 RADIATION EFFECTS ON MECHANICAL PROPERTIES. H. H. W. Losty (General Electric Co., Wembley, Eng.). p.313-24 of "Nuclear Graphite." New York, Academic Press, 1962.

The effects of reactor radiation on the mechanical properties of graphite are reviewed for the following properties: elastic moduli, strength, creep, hardness and machinability, and coefficient of friction. It is concluded that the radioinduced changes will not have any major effect on the operation of a graphite-moderated reactor. (D.L.C.)

3410 STORED ENERGY. R. E. Nightingale (General Electric Co., Richland, Wash.). p.325-53 of "Nuclear Graphite." New York, Academic Press, 1962.

The displaced atoms which do not anneal out during irradiation result in an increase in the heat content of graphite which is called total stored energy (total Wigner energy). The effects of neutron exposure and irradiation temperature on the total stored energy and on the stored-energy release curve are discussed. The theory of energy storage is outlined, and the relation of stored energy to other radioinduced property changes is considered. Safety problems associated with stored energy release are reviewed for several reactor types. (D.L.C.)

3411 ANNEALING RADIATION EFFECTS. R. E. Nightingale (General Electric Co., Richland, Wash.). p.355-86 of "Nuclear Graphite." New York, Academic Press, 1962.

A review is presented on the property changes that result from heating irradiated graphite above the temperature at which it was irradiated. Annealing experiments and their analysis are discussed. Both thermal and radiation annealing are considered. (D.L.C.)

3412 GAS–GRAPHITE SYSTEMS. T. J. Clark, R. E. Woodley, and D. R. De Halas (General Electric Co., Richland, Wash.). p.387-444 of "Nuclear Graphite." New York, Academic Press, 1962.

The properties of some gases as prospective reactor coolants are described. The reactions of graphite with CO_2, O_2, steam, H_2, and other gases are discussed in detail along with radiation effects on these reactions. The development of inhibitors and protective coatings for graphite is discussed. (D.L.C.)

3413 GRAPHITE–METAL AND GRAPHITE–MOLTEN-SALT SYSTEMS. R. A. Meyer and J. C. Bokros (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.445-63 of "Nuclear Graphite." New York, Academic Press, 1962.

The compatibility of graphite with metals and molten salts is reviewed in detail. The following liquid metals were studied: bismuth, lead, sodium, magnesium, aluminum, tin, and uranium. Solid metals and alloys are also considered. The molten salt system studied is the $LiF-BeF_2-ThF_4-UF_4$ system. (D.L.C.)

3414 GRAPHITE-MATRIX FUELS. W. C. Riley and J. Koretzky (Battelle Memorial Inst., Columbus, Ohio). p.465-81 of "Nuclear Graphite." New York, Academic Press, 1962.

Graphite-matrix fuels containing uranium and fabrication methods therefor are reviewed for impregnated, admixed, and lumped fuel elements. The effects of fuel loading particle size on the physical properties are described briefly. The radiation effects and fission-product release from fueled graphite are discussed. (D.L.C.)

3415 GRAPHITE MODERATOR DESIGN. J. C. Fox (General Electric Co., Richland, Wash.). p.483-523 of "Nuclear Graphite." New York, Academic Press, 1962.

The advantages and limitations of graphite as a structural moderator and the considerations involved in designing moderator structures are outlined. The general principles of moderator design are illustrated by descriptions of design features and operating experience of many graphite-moderated reactors of all types. (D.L.C.)

3416 PREPARATION OF REFRACTORY OXIDE CRYSTALS. W. R. Grimes, J. H. Shaffer, and G. M. Watson (to U. S. Atomic Energy Commission). U. S. Patent 3,063,794. Nov. 13, 1962.

A method is given for preparing uranium dioxide, thorium oxide, and beryllium oxide in the form of enlarged individual crystals. The surface of a fused alkali metal halide melt containing dissolved uranium, thorium, or beryllium values is contacted with a water-vapor-bearing inert gas stream at a rate of 5 to 10 cubic centimeters per minute per square centimeter of melt surface area. Growth of individual crystals is obtained by prolonged contact. Beryllium oxide-coated uranium dioxide crystals are prepared by disposing uranium dioxide crystals 5 to 20 microns in diameter in a beryllium-containing melt and contacting the melt with a water-vapor-bearing inert gas stream in the same manner. (AEC)

Corrosion

Refer also to abstracts 3865, 3899, and 3900.

3417 (ANL-FGF-384) ALUMINUM ALLOY CORROSION. W. E. Ruther and J. E. Draley (Argonne National Lab., Ill.). Sept. 5, 1962. 13p. (UAC-6865)

To be published in TID-7642 Proceedings of the Conference on Research Reactors, held in Gatlinburg, Tenn., Sept. 17-19, 1962.

The dynamic corrosion of all the aluminum alloys tested has proven to be particularly sensitive to testing parameters in the 200-325°C temperature range. Frequently it is difficult to reproduce corrosion data in a given dynamic test loop, while variations from laboratory to laboratory have shown rate factors of 25 or more for the same nominal conditions of temperature and velocity. Several hypotheses have now been proposed to account for these variations. An attempt is made to examine some potential research reactor corrosion problems in terms of predictions of the hypotheses. The effect of the high level of radiation encountered in such reactors is an unknown factor and only a full scale in-reactor test can provide final answers. (R.J.S.)

3418 (APAE-Memo-248) A CORROSION STUDY OF WELDED STAINLESS STEEL FUEL ELEMENTS. C. R. Bergen (Alco Products, Inc., Schenectady, N. Y.). Dec. 22, 1960. Contract AT(30-3)-326. 38p.

Fuel element corrosion studies designed to aid in selecting and evaluating SM-2 fuel element welding techniques are discussed. Tests on type 347 ss plate type fuel elements welded by the selected tungsten inert gas technique showed good corrosion integrity of specimens under a variety of conditions including a 500-hr test under simulated SM-2 conditions of flow and coolant chemistry. (auth)

3419 (ARF-2152-18) A MECHANISM FOR STRESS-CORROSION EMBRITTLEMENT. Final Report, June 15, 1958–September 30, 1961. P. R. V. Evans and Robert H. Read (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 27, 1961. Contract Nonr-2602(00). 91p.

The stress-corrosion cracking behavior of 304 stainless steel in $MgCl_2$ at 140°C has been studied. Tensile deformation behavior in the vicinity of the yield point suggested that there is no measurable Rebinder Effect or Roscoe Effect. In static tensile tests, the time to failure was found to decrease with applied stress in agreement with previous work. No incubation period prior to the onset of cracking was noted, while varying the time in solution prior to the application of stress had no effect on subsequent stress-induced failure. Prestressing at various temperatures in air in the range 140°–500°C was found to influence subsequent time to failure at 140°C in $MgCl_2$. Cyclic loading treatments were found to have no influence on time to failure, and there was no evidence of rapid crack propagation characteristic of brittle fracture. Prior deformation carried out at various temperatures reduced the susceptibility of 304 stainless steel. Microstructure was also found to strongly influence cracking behavior; strain-induced martensite resulted in a marked increase in resistance to failure. In the earlier part of the program it was shown through the Stroh-Petch equation relating fracture stress and grain size that stress-corrosion environments can lead to a lowering of the surface energy associated with the formation of fracture surfaces. A variety of materials and corrosion media were examined. During the final year's work it was demonstrated that the

mechanism of stress-corrosion cracking depended on the simultaneous action of both electrochemical and mechanical processes. Using a variety of experimental conditions, efforts to separate the electrochemical and mechanical contributions to the phenomenon proved unsuccessful. (auth)

3420 (BLG-124) OXYDATIE VAN MAGNESIUM EN VAN MAGNESIUM–ZIRKONIUM IN VOCHTIGE LUCHT. (Oxidation of Magnesium and Magnesium–Zirconium in Humid Air). R. Van Sinay and G. J. Spaepen (Brussels. Centre d'Etude de l'Energie Nucléaire). Apr. 1962. 18p.

The corrosion resistance of Mg and of Mg-Zr was tested because of their possible use as cladding materials for BR1 fuel elements. The effects of surface treatment, hydrofluoric acid, thermal cycling, and welding, on the corrosion of these materials in humid air were determined. It is concluded that Mg is suitable for use in humid air up to 350°C. (auth)

3421 (BNL-5574) POSSIBLE CORRELATIONS BETWEEN THERMOELECTRIC POTENTIALS AND LIQUID METAL CORROSION. John R. Weeks (Brookhaven National Lab., Upton, N. Y.). [1960]. Contract [AT-30-2-GEN-16]. 6p.

A possible explanation is set forth for the following two liquid metal corrosion phenomena: selective attack on certain alloys that differ only slightly in composition from adjacent material and the rapid increase in steel solution rate observed when the temperature differential in a circulating system is increased. An experimental program with steel and liquid bismuth is described in which it is assumed that thermoelectric potentials between the corroding surface and the liquid metal influence the dissolution process. (R.J.S.)

3422 (DP-694) REPAIR OF HEAT EXCHANGERS DAMAGED BY STRESS CORROSION. SAVANNAH RIVER PLANT. H. W. Bellas (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). Apr. 1962. Contract AT(07-2)-1. 23p.

Failure by chloride stress-corrosion cracking occurred in the austenitic stainless steel tubing of a number of shell-and-tube heat exchangers at the Savannah River Plant. Since ample replacement units were not readily available, it was necessary to make repairs. Development of repair methods was required due to the unique construction of the units, and due to the fact that only a short length of tubing between double tube sheets was affected. A number of potential repair methods were evaluated, and two were chosen for development. Due to the more rapid development of a rolled-in ferrule method and the urgent need for repair, only this method was applied to the two heat exchangers that were repaired. While zero leakage was not attained, a tolerable leakage rate of 0.1 gal/day was attained. Development of a welded-in, stub-end repair method was completed. (auth)

3423 (GA-2998) EXPOSURE OF REACTOR STRUCTURAL MATERIALS TO IMPURE HELIUM AT ELEVATED TEMPERATURES. A. F. Weinberg and J. M. Scoffin (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 22, 1962. Contract AT(04-3)-314. 34p.

In the High-temperature Gas-cooled Reactor (HTGR), structural metals will be required to operate at temperatures of 1000 to 1400°F in an impure-helium environment for extended periods of time. Six candidate materials for such applications, including nickel alloys and stainless steels, were subjected to simulated reactor environments for times up to 3000 hr to evaluate the extent of corrosion and the changes in mechanical properties occasioned by such exposures. Under the experimental exposure conditions (helium containing 200 to 300 ppm CO and 200 to 300 ppm H_2, or helium containing 2000 to 3000 ppm CO and 2000 to 3000 ppm H_2, at temperatures of 1200 or 1400°F), oxidation rather than carburization appears to be the major corrosion process; however, in some cases alternating carburization and decarburization were observed. Measurements of weight gains are described. None of the materials studied exhibited a large change in their mechanical properties after exposures at 1200°F. After exposures at 1400°F, moderate changes in mechanical properties were observed for all materials except Type 321H stainless steel, which exhibited a large decrease in ductility after 1500-hr exposure to the higher impurity concentration. In general, the control specimens were affected as greatly as the specimens exposed to the impure helium environments, under the conditions of these tests. (R.J.S.)

3424 (KAPL-M-WKA-16) EFFECT OF A.C. HEATING OF ZIRCALOY CORROSION SPECIMENS IN STAINLESS STEEL LOOPS. W. Kermit Anderson and Craig Cheng (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 11, 1962. Contract W-31-109-eng-52. 41p.

The cell composed of oxidized zirconium alloy and oxidized stainless steel immersed in somewhat alkaline high purity water was studied under conditions where various amplitudes and frequencies of a-c were applied to the electrodes. The behavior of the cell is explained on the basis of an electronic equivalent circuit in which the Zircaloy-2-zirconium oxide electrode is represented by a diode in series with a resistance shunted by a high value electrolytic capacitor. The stainless steel-oxide electrode cannot rectify a-c and hence is represented by a leaky electrolytic capacitor in parallel with its leakage resistance. Significant a-c voltages of the order of three to ten volts, must appear across the cell before rectification begins even at 60 cycles/second. This is due to the fact that, at lower voltages, the series resistance appearing in the system acts to drop voltage across the diode to near zero with essentially infinitesimal current flow. When frequency is increased to about 400 cycles/second or above, the reactance of the electrolytic capacitor (double layer) shunting the diode-leakage resistance combination in the Zircaloy electrode equivalent circuit is so low that the diode-series resistor combination is effectively shorted out, and hence no direct current flows. When two Zircaloy-oxide electrodes are used in a cell upon which an a-c voltage is imposed, even though the voltage is of fairly high amplitude, no rectified current will flow. This is consistent with the theory, since the two diodes would be in bucking orientation in the circuit and would hence present a net d-c voltage of zero across the cell. Heating can be carried out by any of the following three methods without causing any electrolytic corrosion effect: design the experiment to be operated at 60 cycles and the specimen so that voltages imposed across it will be below those at which rectification ensues; design the equipment to operate at frequencies of 400 cycles/second or above; and line the test chamber portion of the loop with Zircaloy kept at ground potential with respect to the specimen so that the polarity of the oppositely oriented diodes will be bucking, and hence all d-c voltages cancelled so that no direct current will flow. By such means, corrosion tests can be run in loops using a-c to heat specimens by their own resistance with no ill effects. (auth)

3425 (MSAR-62-126) EFFECT OF 1200°F SODIUM ON AUSTENITIC AND FERRITIC STEELS. PHYSICAL PROPERTIES OF MATERIALS. Progress Report No. 25,

September 1962. (MSA Research Corp., Callery, Penna.). Oct. 19, 1962. Contract AT(11-1)-765. 41p.

Results are of a preliminary nature at this time, but the sodium and air stress-to-rupture tests with 316 stainless steel specimens show excellent agreement indicating no noticeable effect of sodium. The creep tests of 316 stainless steel specimens resulted in higher creep rates in sodium than in air, which may indicate the shape of the creep curve to be different in sodium than in air. The fatigue tests are not complete but preliminary results indicate Type 316 stainless steel has a longer fatigue life in helium and sodium than in air, especially under lower cyclic strain. The Cr-Mo steel stress rupture results show a slight difference between the air and sodium tests with indications that sodium might be expected to shorten the stress rupture life of 2¼ Cr–1 Mo steel at these high temperatures. Higher creep rates were also experienced in sodium than in air, indicating the possibility of different shaped creep curves in sodium than in air. The fatigue tests show no difference between sodium and helium tests but both show longer fatigue life than tests in air. (R.J.S.)

3426 (NP-12189) CESIUM CORROSION STUDIES, QUARTERLY PROGRESS REPORT FOR PERIOD DECEMBER 16, 1961 TO MARCH 15, 1962. W. Chandler (Rocketdyne. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 31, 1962. Contract AF 33(616)-8435. 68p. (R-3202-3)

The static capsules for investigating the effects of cesium liquid and vapor on type 310 stainless steel, Inconel X, zirconium, hafnium, niobium, tungsten, tantalum, molybdenum, and niobium-zirconium alloy were prepared, loaded, and sealed. A detailed description of experimental techniques and of the static test system is presented. The static test run is under way. The boiling-refluxing capsules are being prepared for loading with cesium and sealing. A paper by W. Unterberg entitled "Thermal Design of Liquid Metal Gravity Reflux Capsules" is included. (auth)

3427 (NP-12233) BEARING MATERIALS FOR PROCESS FLUID LUBRICANTS. Progress Report. M. B. Peterson (Mechanical Technology Inc., Latham, N. Y.). Sept. 11, 1962. Contract Nonr-3731(00)(FBM). 41p. (MTI-62TR20)

Materials with sufficient corrosion resistance to be considered as bearing materials for water and steam are alloys of Al, Co, Cu, Au, Fe, Ni, Pt, Ag, Ta, Ti, and Zr. Solubility, soft oxide film formation, crystal structure, melting temperature, recrystallization temperature, thermal conductivity, and hardness were examined. Considered most promising in the temperature range of 350 to 500°F were Co, Cu, Au, and Pt alloys. (R.J.S.)

3428 (ORNL-TM-417) SUPPLEMENTAL STUDIES OF THE CORROSION OF MATERIALS OF CONSTRUCTION FOR THE DAREX PROCESS. W. E. Clark, L. Rice, D. N. Hess, and E. S. Snavely (Oak Ridge National Lab., Tenn.). Nov. 19, 1962. Contract [W-7405-eng-26]. 13p.

The use of fluoride to control silica in the Darex Process increased the corrosion rate of titanium from ≪1 mil/mo to 7-75 mils/mo depending upon whether Al^{+3} or Zr^{+4} was added to complex the fluoride. In $HNO_3-Hg(NO_3)_2$ dissolvent for aluminum fuels and $HNO_3-Fe(NO_3)_3$ dissolvent for U–Mo fuels, titanium corroded at rates <1 mil/mo for exposures of 500 to 1000 hr. High-cobalt alloys show some promise for use in equipment for combined Darex, Zirflex, and Modified Zirflex Processes for reprocessing stainless steel, zirconium-clad UO_2, and Zr–U alloy fuels, respectively. The lowest rates obtained in initial Darex environments were <0.4 mil/mo and were obtained on Haynes 25. Intergranular attack was observed but could doubtless be minimized or eliminated by use of a low-carbon modification of the alloy. Use of high-cobalt alloys in the Darex Process would probably necessitate the use of low-temperature stripping of chloride with NO_2 instead of with boiling concentrated HNO_3. (auth)

3429 ISOTHERMAL MASS TRANSFER OF ALUMINIUM ONTO MOLYBDENUM IN LIQUID METALS. A. K. Covington, J. D. Baird, and A. A. Woolf (Associated Electrical Industries, Aldermaston, Berks, Eng.). J. Nucl. Energy Pt. A and B, 16: 355-67(July 1962).

The rate of growth has been studied of the alloy layer formed on molybdenum when it is immersed in solutions of aluminium in the liquid metals, bismuth, cadmium, indium, lead, thallium, or tin at 500°C. The published work on the aluminium-molybdenum phase diagram is surveyed and from this and some additional studies the compounds in the alloy layer were identified as Al_3Mo, Al_5Mo, and $Al_{12}Mo$. The only other well-established compound in the system $AlMo_3$, was found to grow too slowly at this temperature to be observed in the layer. Considerable differences were found in the rates of growth and composition of the alloy layer in the different solvent metals. The solubilities and rates of solution of aluminium in the solvent metals were measured in order to elucidate the rate controlling step in the mass transfer and its dependence on the liquid metal. Provided that the liquid metal was saturated with aluminium in the vicinity of the molybdenum, diffusion in the solid state was the rate controlling step. However, this condition was not satisfied for those liquid metals in which aluminium was sparingly soluble (e.g., lead) and under our test conditions the rate of solution was found to be of the same order as the rate of removal of aluminium by alloying. The implications of these results on the use of liquid metals in reactor technology is discussed. (auth)

3430 PENETRATION RATE STUDIES OF STAINLESS STEEL BY MOLTEN URANIUM AND URANIUM-FISSION ALLOY. C. M. Walter and L. R. Kelman (Argonne National Lab., Ill.). J. Nucl. Mater., 6: 281-90 (Aug. 1962). (In English)

The rate of penetration of Type 304 stainless steel by molten uranium and uranium–5 wt% fissium alloy was investigated by a dip method in the range 1100 to 1350°C. For the uranium–5 wt % fissium alloy the rate was found to increase rapidly from 0.6 mils/sec (1.5×10^{-3} cm/sec) at 1100°C to 12 mils/sec (3×10^{-2} cm/sec) at 1150°C. It then sharply reversed, decreasing to 2.5 mils/sec (1.3×10^{-3} cm/sec) at 1187°C following which it gradually increased to 5 mils/sec (1.3×10^{-2} cm/sec) at 1350°C. Molten uranium was found to be somewhat more aggressive than molten uranium–5 wt % fissium alloy. The rates to penetrate 304 stainless steel were 15 mils/sec (3.8×10^{-2} cm/sec) at 1150°C, 4 mils/sec (1×10^{-2} cm/sec) at 1187°C, and 6.5 mils/sec (1.65×10^{-2} cm/sec at 1350°C. The unexpected reversal in penetration rate with temperature was attributed to the formation of an intermetallic compound which retards the reaction. It was found that surface film formation and phase transformation in the stainless steel were not the cause of this reversal. (auth)

3431 THE AQUEOUS CORROSION OF REACTOR METALS. J. N. Wanklyn and P. J. Jones (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nucl. Mater., 6: 291-329(Aug. 1962). (In English)

The literature of the corrosion of metals used in high- and low-temperature water-cooled reactors is reviewed and technological and scientific advances in this field are assessed. The review extends to the latter part of 1961. (auth)

3432 UNTEMPERED MARTENSITE AFFECTS STRESS CORROSION OF TYPE 410 STAINLESS. Henry Suss (Knolls Atomic Power Lab., Schenectady, N. Y.). Metal Progr., 82: No. 5, 89-91; 122; 124(Nov. 1962).

Research on heat treated specimens of type 410 which had cracked in stress-corrosion tests (after chromium plating) revealed that improper heat treatment was responsible—because of incomplete quenching untempered martensite appeared on cooling from tempering. The degree of stress-corrosion cracking was directly related to the amount of untempered martensite present. (auth)

3433 DEPOSITION AND RELEASE OF CORROSION PRODUCTS IN SM-1. C. Richard Bergen (Alco Products, Inc., Schenectady, N. Y.). Nucleonics, 20: No. 7, 70; 72; 74-5(July 1962).

Corrosion-product-film growth and release rates in a coolant stream in an all-stainless-steel SM-1 reactor are measured for periods up to 10.5 khr after initial startup. Data and applicable calculation methods are discussed. (T.F.H.)

3434 THE CHEMICAL AND HEAT RESISTANCE OF THE NITRIDES OF THE THIRD GROUP. M. D. Lyutaya and V. F. Bukhanevich (Inst. of Metal Ceramics and Special Alloys, Ukrainian Academy of Sciences, SSR). Zh. Neorgan. Khim., 7: 2487-94(Nov. 1962). (In Russian)

Powdered and hot-pressed specimens of the nitrides of Al, Ga, In, and Sc were subjected to chemical attack and to high temperatures in order to clarify the contradictory data in the literature. Exposure to concentrated and diluted HCl and HNO_3 at room temperature and at the boiling point indicated that their resistance decreases in the following order: GaN > AlN > InN while a reverse order was noted in solutions of alkalis. GaN, InN, and ScN were found to be quite resistant against the action of cold and boiling water. AlN compacts withstood attack by boiling H_2SO_4 and NaOH solutions. Studies of the behavior of these materials at elevated temperatures showed that AlN, GaN and ScN are not oxidized in air up to 800, 700, and 600°C, respectively but InN is completely decomposed when exposed to 350°C in air, yielding In_2O_3. (TTT)

3435 CONTRIBUTION TO THE STUDY OF THE CORROSION OF NIOBIUM AS A FUNCTION OF ATMOSPHERE AND OF TEMPERATURE. Walter Stuckens and Roger Durand. Prepublication Copy. 24p. (In French)

The effect of oxygen, air, carbon dioxide, and nitrogen on the corrosion of pure niobium was studied in a wide temperature range. The corrosion kinetics were followed by thermogravimetric analysis. The results showed good behavior up to 400°C in oxidizing atmosphere. Above this temperature Nb is sensitive to the action of nitrogen and carbon dioxide, but principally to air and oxygen. Although the corrosion kinetics are different, the mechanical properties are deeply modified as a result of the diffusion of oxygen and nitrogen into the metal. Studies on Nb fused in an electron beam furnace showed that this treatment did not sensibly improve the oxidation behavior. It was also indicated that the Nb used had properties closer to those of Ta than is generally admitted. The initial stage in the oxidation was independent of temperature but was connected to the grain orientation. This process controls the oxidation up to 600°C. Beyond that temperature, oxidation is rapid and is controlled by the diffusion of oxygen and of the metal crossing the oxide layer initially formed. (tr-auth)

3436 COATING OF METAL WITH LAYERS OF TITANIUM ESTERS AND A POLYMER BY EXPOSURE TO HIGH ENERGY IRRADIATION. Harold W. Coles and Stanley E. Rohowetz (to U. S. Army). U. S. Patent 3,061,483. Oct. 30, 1962.

A protective coating is applied to an oxidizable metal surface, such as magnesium or aluminum, and is subsequently exposed to ionizing radiation. The coating system consists of an organic titanate and a coating selected from a group of alkyd phenolic primers containing zinc chromate, polyurethanes, or siloxanes. (R.J.S.)

Fabrication

Refer also to abstracts 2745, 2764, 2765, 2772, 3862, 3863, 3864, and 3867.

3437 (AD-277459) DEVELOPMENT OF A DUCTILE TUNGSTEN SHEET ALLOY. Summary Report, April 26, 1961–April 26, 1962. J. L. Ratliff, D. J. Maykuth, H. R. Ogden, and R. I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). May 26, 1962. Contract NOw 61-0677-C. 87p.

In the binary-dispersion-alloy studies, additions up through 12 vol % of thoria and zirconia were investigated. Thoria was added as an aqueous solution of thorium nitrate, while zirconia was added both as an aqueous solution of zirconium sulfate and as a 0.01-μ colloid. All of the thoriated alloys also contained a 0.2 wt % addition of Na_2O, while the zirconia alloys were prepared with and without the Na_2O addition. It was shown that the fine dispersions of thoria and zirconia obtained appeared to have equivalent effects, on a vol % basis, on the fabricability, bend transition temperature, and recrystallization behavior of tungsten. The method of adding zirconia had no significant effects on end properties, although use of the colloid entailed less difficulty and gave results more consistent than those obtained with the aqueous salt. (auth)

3438 (ARF-2220-18) DEVELOPMENT OF 2400°F FORGING DIE SYSTEM. Interim Technical Progress Report, June 28, 1962–September 27, 1962. H. Nudelman, A. H. Murphy, T. Watmough, and P. R. Gouwens (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 1962. Contract AF33(600)-42861. 56p. (ASD-TR-7-886(VI))

A program to improve fabrication processes for aircraft and missile components is reported. The ultimate objective of the research is development of forging processes for refractory metals with dies operating at about 2400°F. During the report period, research directed toward reducing the number of die sequences conventionally required to produce a selected forging was completed. It was demonstrated that this forging can be produced directly from hot-rolled bar stock. Candidate die materials including TiB_2, SiC, and Refrax were evaluated for operation at 2400°F. These materials withstood upsetting loads encountered in room-temperature press-forging of mild steel blanks which simulates pressures required for refractory metals at 3000°F. (J.R.D.)

3439 (ASD-TR-7-532a(VIII)) MACHINING OF REFRACTORY MATERIALS. Phase II Technical Engineering Report, August 1, 1962–October 31, 1962. N. Zlatin, M. Field, and J. Gould (Metcut Research Associates Inc., Cincinnati). Nov. 1962. Contract AF33(600)-42349. 82p.

An evaluation of a Tornetic drilling unit and tapping unit is in progress. The torque and speed characteristics of these units have been determined. Comparative drilling tests using the Tornetic drilling unit and a constant feed and speed drill press have been made on 4340 steel quenched and tempered to 52 R_C, B-120VCA titanium solution treated and aged to 400 BHN and Rene 41 solution treated and aged to 370 BHN. Conventional machining studies were performed on B-120VCA titanium in the solution-treated condition (285 BHN), and the aged condi-

tion (400 BHN). The investigation consisted of turning, face milling, end milling, drilling, reaming, tapping, and grinding tests. (auth)

3440 (BMI-1602) CLADDING UO_2 WITH BERYLLIUM BY GAS-PRESSURE BONDING. Stan J. Paprocki, Edwin S. Hodge, Hugh D. Hanes, James H. Peterson, and Glenn R. Goetsch (Battelle Memorial Inst., Columbus, Ohio). Nov. 13, 1962. Contract W-7405-eng-92. 15p.

Contamination-free beryllium-to-beryllium bonds were achieved by gas-pressure bonding at 1550 to 1650°F for 4 hr at 10,000 psi. Bonds produced with grit-blasted surfaces exhibited up to 50 per cent grain growth across the interface while those produced by shapering showed less grain growth. Although all of the beryllium-clad UO_2 fuel elements prepared possessed cracks in the cladding, the feasibility of this materials combination was proven by the bonds obtained between all of the beryllium components. The cracks appeared to be a result of reaction with the spacer material used in the bonding container rather than because of the inherent properties of beryllium or any of the fabricating procedures. (auth)

3441 (ERR-FW-043) DEVELOPMENT OF BRAZED BERYLLIUM SANDWICH CONSTRUCTION. S. V. Glorioso, D. P. O'Keefe, and C. W. Rogers (General Dynamics/Fort Worth, Tex.). Dec. 1960. Contract 14-60-597. 31p. (AD-276008)

Eight commercially available brazing alloys were evaluated for fillet formation, flow, and strength when joining Be to itself, Ti, and 17-7 pH steel. Problems of brazing atmosphere, stop-off, and detail part fabrication were solved in order to braze several small Be sandwich panels. Some progress was reported in the development of a braze alloy specifically for Be. (R.J.S.)

3442 (ERR-FW-064) BERYLLIUM SHEET FABRICABILITY PROGRAM. W. R. Bear (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Dec. 30, 1960. Contract 14-60-599. 24p. (AD-275962)

The fabricability and material properties program conducted on 0.060- and 0.020-in. Be sheet is discussed. Cutting and drilling techniques were investigated. Tensile tests were conducted to evaluate material uniformity. The primary objective of the program, the fabrication and testing of a plate-stringer panel to establish correlation between theoretical and actual design properties, was not attained owing to inadequate ductility. The information obtained should advance the use of this type of structural material in aerospace vehicles. (auth)

3443 (HW-SA-2689) HANFORD PROGRAMS FOR ADVANCED PLUTONIUM FUEL DESIGNS AND FABRICATION METHODS. E. A. Evans (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Sept. 12, 1962]. Contract AT(45-1)-1350. 39p.

Developments in each area of fuel technology which reduce plutonium-bearing fuel costs are discussed. Fabrication studies are described and methods compared. It was concluded that processes must be further simplified, adapted to remote operation, and integrated to obtain an overall process which can be conducted remotely in the smallest possible hot cell. (M.C.G.)

3444 (KAPL-M-RXH-1) MANUFACTURING ZIRCALOY RHOMBIC RODS. R. A. Hamberger and B. Dobies (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 1, 1962. Contract W-31-109-eng-52. 9p.

A method for manufacturing rhombus-shaped Zircaloy rods was developed. Standard rolling mill and Turk's head equipment was used. The final shape of the rhombic rods was very near that of a true rhombus or, more accurately, a parallelogram. The corners across the long diagonal were not sharp but contained a slight radius. The final thickness dimensions varied less than 0.002 in. in a 48-in. length, and after straightening, the rods bowed less than 0.010-in. along a 48-in. length. (M.C.G.)

3445 (NP-12225) COLUMBIUM ALLOY EXTRUSION PROGRAM. PHASE V. TUBING PROGRAM. Interim Report VI. July 15, 1962–October 15, 1962. James S. Clark (Du Pont de Nemours (E. I.) & Co. Metals Center, Baltimore). Contract AF33(600)-40700. 49p.

The Nb and Nb alloy extrusion program was revised from the pilot production of D-31 "T" sections to the goal production of tubing of the alloys X-110 (Nb-10W-1Zr-0.1C) and B-66 (Nb-5Mo-5V-1Zr). Progress in the first 3-month period of this revised program is described. Two 8-in. dia ingots of each alloy were melted and converted to 4-in. dia billet stock by extrusion. Tube blank extrusions of 8 :1 ratio were made from 3200 to 3400°F. The effects of various process parameters are reported, and the future program is discussed. This will include additional tube blank extrusions and a tube-reducing program. (auth)

3446 (NP-12256) DEVELOPING TECHNOLOGY TO FORGE UNCLAD BERYLLIUM. Phase I. Final Report, April 16, 1962–July 31, 1962. Technical Report No. 280-237. M. B. Hornak and R. G. O'Rourke (Brush Beryllium Co., Cleveland). Sept. 10, 1962. Contract AF33(657)8507. 52p.

A review of a state-of-the-art survey is presented in addition to results from a limited amount of experimental forging of unclad Be billets employing upset forging methods. Also, an engineering plan for Phases II and III of this project is presented in moderate detail. (auth)

3447 (PREDC-759) COMPREHENSIVE SUMMARY REPORT ON 80 NICKEL-20 CHROMIUM FUEL ELEMENTS. F. C. Robertshaw (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Oct. 1960. Contract AT(11-1)-171. 223p.

The development of 80 Ni–20 Cr fuel elements with UO_2 dispersed in the matrix is described. A summary is provided of the fueled ribbon and elements of the concentric ring type produced and tested. The historical development, design, materials, and component evaluation are discussed. Over 12,950 fuel element stages were produced from over 125,000 ft of fuel ribbon. (M.C.G.)

3448 (TID-14889) AN UNDERWATER SAW FOR EBWR REACTOR VESSEL. C. E. Paschall and B. K. Snyder (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-eng-38. 8p. (UAC-5904)

Design and operation of an underwater saw for remotely cutting control rods in the Experimental Boiling Water Reactor are discussed. A commercially available portable reciprocating unit was employed. (R.J.S.)

3449 (WADD-TR-61-72(Vol.XI)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XI. CHARACTERIZATION OF BINDERS USED IN THE FABRICATION OF GRAPHITE BODIES. E. de Ruiter, A. Halleux, V. Sandor, and H. Tschamler (Union Carbide European Research Associates, Brussels). Aug. 1962. Contract AF33(616)-6915. 23p.

A series of chemical and physical methods, developed for use in the study of the constitution of coals, was applied to the definition of structural parameters for 13 tar and pitch samples that have a wide range of properties and that are of interest in the fabrication of graphite bodies. Information obtained on the molecular size and composition indicates the presence of polycyclic compounds with a

high degree of aromaticity. Evidence also points to the importance of large aromatic clusters. (auth)

3450 (NP-tr-924) PROCESS FOR THE MANUFACTURE OF HIGH DENSITY GRAPHITE PIECES. Translated by Martin Greenwood (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from German Patent 1018777. Oct. 1937. 4p.

A process is briefly discussed to produce graphite shapes of high strength and high density. The process involves preliminary crushing so that no appreciable flake formation remains. The graphite to be molded is subjected to precompression at low pressure and the blanks, after crushing, are finally compressed at high pressure. (R.J.S.)

3451 PRODUCTION SINTERING OF URANIUM DIOXIDE. Lars Halle. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 271-88(1962). (In English)

A plant for the manufacture of sintered UO_2 pellets for use in nuclear reactors is described. UO_2 powder and lubricant are mixed, pressed, and sintered at about 1700°C to a density of up to 98 per cent of the theoretical density. The pellets are ground to close diameter tolerances before being inserted into the fuel-element canning tubes. Some results are also presented in the paper from the development started at ASEA in 1957 with the object of evolving methods and equipment for the manufacture on production scale of sintered UO_2 pellets. In addition, checking and analytical methods are briefly discussed, and some results and experience from the manufacturing of, for example, about 12 tons of UO_2 pellets for the Swedish R3/Adam reactor are presented. Finally, comments are made on protection measures and health control. (auth)

3452 STAGES OF INVESTIGATION AND DEVELOPMENT IN THE FABRICATION OF FUEL ELEMENTS OF THE ARGOS I AND II REACTORS. M. López Rodríguez. Energia Nucl. (Madrid), 6: 87-94(Jan.-Mar. 1962). (In Spanish)

The time schedule for the study and development of installations and methods for the fabrication of Argos fuel elements is reviewed. (J.S.R.)

3453 FABRICATION OF FUEL ELEMENTS FOR THE ARGOS I AND II REACTORS. H. Bergua, A. Fornes, G. Gerbolés, J. Redondo, and A. de Las Rivas (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 95-104(Jan.-Mar. 1962). (In Spanish)

The Argos fuel elements are composed of U_3O_8 dispersed in Al and covered with Al. The steps in the fabrication of these fuel elements (the preparation of the fuel core, cladding of the core, and quality control) are described separately and in detail. (J.S.R.)

3454 INSTALLATIONS FOR THE FABRICATION OF THE FUEL ELEMENTS FOR ARGOS I AND II REACTORS. Jacobo Díaz Díaz and José Maroto Muñoz (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 105-12 (Jan.-Mar. 1962). (In Spanish)

A brief description is given of the installations for fuel element fabrication, with emphasis on the blending compartments, air filtration, ventillation, drying, and compression. (J.S.R.)

3455 INSPECTION DURING THE FABRICATION OF THE FUEL ELEMENTS FOR THE ARGOS I AND II REACTORS. José Ángel Cerrolaza Asenjo and Antonio Marín Garcia (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 113-22(Jan.-Mar. 1962). (In Spanish)

The quality control during the fabrication of the Argos I and II fuel elements is described. The nondestructive testing of plates, rods, and laminated fuels is discussed with examples of autoradiographic and radiographic test results. (J.S.R.)

3456 PREPARING U^{233} FUEL FOR AETR CRITICAL EXPERIMENTS. James R. Foltz, Lothar Abraham, and Donald Stromінger (Atomics International, Canoga Park, Calif.). Nucleonics, 20: No. 11, 87-9(Nov. 1962).

The preparation, fabrication, and radiation levels of U^{233} as U_3O_8 in stainless steel-clad platelets for a critical experiment for studying the Advanced Epithermal Thorium Reactor concept are described. The U^{233}, initially in the form of an impure $UO_2(NO_3)_2$ solution, was treated to remove thorium, denitrated, calcined, and fabricated. Inspection and radiation intensity of the platelets 2 months after treatment are discussed. (D.L.C.)

3457 SOME OBSERVATIONS ON THE COLD-DRAWING AND ANNEALING BEHAVIOUR OF NICKEL CONTAINING A DISPERSED PHASE OF THORIA. V. A. Tracey and D. K. Worn (International Nickel Co. (Mond) Ltd., Birmingham, Eng.). Powder Met., No. 10, 34-48(1962).

Consideration is given to the effects of cold drawing and subsequent heat treatment on the mechanical properties of extruded Ni – 2.5 vol.-% thoria rod, prepared from mechanically mixed nickel and thoria powders. It is shown that the extruded alloy may be reduced >80% in area using no intermediate annealing treatments, with significant beneficial effect on the room-temperature tensile strength and on the stress-rupture properties at 815°C. The cold-drawn alloy has marked resistance to annealing at temperatures in excess of 1000°C. Comparative data are given for pure Ni. The effects of cold drawing and subsequent heat treatment on the structure of the alloy are then discussed with reference to changes in the dispersed phase and in the matrix revealed by electron microscopy and by x-ray diffraction studies. (auth)

3458 PRODUCTION OF HIGH DENSITY SINTERED URANIUM OXIDE. Harold Rawson and Charles Anthony Elyard (to Associated Electrical Industries Ltd.). U. S. Patent 3,063,793. Nov. 13, 1962.

Sintered uranium dioxide ceramic material of high density is produced by using as the starting material a mixture of an oxide of uranium in the composition range $UO_{2.1}$ to $UO_{2.25}$ with a surface area of the order of 2 m^2/g. Up to 0.1 wt % of platinum is uniformly dispersed over the surface of the oxide particles. (R.J.S.)

3459 METHOD OF BRAZING. P. Patriarca and G. M. Slaughter (to U. S. Atomic Energy Commission). U. S. Patent 3,065,537. Nov. 27, 1962.

A method of joining metal surfaces is given. Surfaces having nickel or iron as the base metal are joined together with a brazing composition consisting of 80% nickel, 10% phosphorus, and 10% chromium. (AEC)

Properties and Structure

Refer also to abstracts 2748, 3866, 3897, 3898, 3902, 3903, 3904, and 3906.

3460 (AD-273802) A CORRELATION OF PROPERTIES FOR VARIOUS FORMULATIONS OF SINTERED ZIRCONIA. UNPUBLISHED DATA. VOLUME 3, PHASE I. Quarterly Report No. 4. D. T. Lowrance (Chance Vought Corp., Dallas). Mar. 15, 1962. Contract AF 33(616)-7986. 95p. (CVC-2-53420/2R375)

This report consists of mechanical and physical properties data of various binary and ternary formulations of ZrO_2, a correlation of measured thermal shock data of ZrO_2 with known thermal shock expressions, and interpre-

tations of various criteria that are developed. Measurements of the thermal shock, expansion, emittance, strength, thermal conductivity and heat capacity data were made. (auth)

3461 (AD-273895) HIGH TEMPERATURE CERAMIC STRUCTURES. Quarterly Report No. 22, November 1, 1961 to January 31, 1962. N. E. Poulos, S. R. Elkins, and J. D. Walton (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract NOrd-15701. 32p.

Effort was directed toward $AlCl_3$ impregnating studies and radome fabricating studies. The $AlCl_3$ studies were continued to determine the impregnating method that would increase the strength and decrease the porosity of slip-cast fused silica. Four different impregnating methods were evaluated and found effective in the following order: simple exposure, boiling, vacuum-pressure, and pressure. The order according to effectiveness in increasing transverse strength was vacuum-pressure, pressure, simple exposure, and boiling. The effects of surface skin (fine particles of fused silica developed during initial casting) removal were studied in conjunction with $AlCl_3$ studies. In general, the removal of the surface skin decreased the strength of the slip-cast fused silica impregnated by 4 impregnating methods. The bulk diffusion rate and the tendency to develop closed pores were decreased. A procedure was developed for pressure casting radomes from fused silica slips that provided a casting time of 80 minutes, or a reduction of about 9 hr over conventional slip-casting procedures to form a $\frac{3}{8}$-in.-thick × 15-in.-diam × 32-in.-high radome. (auth)

3462 (AD-275938) AN INVESTIGATION OF THE CRACK-PROPAGATION RESISTANCE OF HIGH-STRENGTH ALLOYS AND HEAT-RESISTANT ALLOYS. Bimonthly Progress Report No. 8, February 23, 1962 through April 23, 1962. W. R. Salzman and J. D. Morrison (Southern Research Inst., Birmingham, Ala.). May 23, 1962. Contract NOw-61-0392-d. 17p.

The crack-propagation properties and standard tensile properties of the Nb-base alloy FS-82 sheet and unalloyed W sheet are given. The properties of FS-82 sheet were investigated throughout the temperature range −320° to 1400°F; the properties of unalloyed W sheet were investigated throughout the temperature range 75° to 2200°F. (auth)

3463 (AD-276411) HEAT DIODE CONVERTER. Interim Scientific Report No. 4, February 1, 1962—April 30, 1962. (Westinghouse Electric Corp. Research Labs., Pittsburgh). May 20, 1962. Contract AF33(616)-8262. 89p.

Work on the thermionic emission properties of refractory materials in cesium vapor progressed and some new features of the behavior of refractory metals in high cesium pressure were observed. Measurement was continued of saturation emission currents in a cesium plasma anode discharge tube. The electron reflection measurement technique proved satisfactory, and a set of experiments for copper is reported. A complete set of measurements was taken for the thermal conductivity of cesium vapor. A complete analysis was carried out for all the previously done measurements of the evaporation of molybdenum in cesium vapor. (auth)

3464 (ARA-1029) STUDY OF MATERIALS FOR THERMIONIC CONVERTERS. Summary Report No. 1. Philip Goodman and Harold Homonoff (Allied Research Associates, Inc., Boston). Dec. 31, 1961. Contract Nonr-3385 (00). 80p. (AD-273533)

An examination was made of the fundamental properties of materials, from a solid-state physics and chemistry point of view, with regard to those properties which most influence their performance in thermionic converters. The underlying structural causes which determine the values of such material properties as work function, electron affinity, heat of vaporization, vapor pressure, thermal conductivity, Fermi level, etc. were examined for metals, insulators, and semiconductors. Both quantitative calculations and qualitative correlations for various material classes are discussed. In connection with this study, a compilation was made of experimentally determined thermionic work functions and Richardson A values for most non-elemental emitters. (auth)

3465 (ASD-TDR-62-594) INVESTIGATION OF TANTALUM AND ITS ALLOYS. Frank F. Schmidt, Albert G. Ingram, William D. Klopp, Edwin S. Bartlett, and Horace R. Ogden (Battelle Memorial Inst., Columbus, Ohio). Mar. 1962. Contract AF33(616)-7688. 246p.

Fabrication results, bend ductility, tensile properties at low and high temperature, high-temperature stress-rupture data, welding studies, metallurgical studies (both recrystallization behavior and heat treatment), and oxidation behavior of tantalum and tantalum-base alloys, are presented. Several tantalum-base alloys were found to have outstanding strength properties at temperatures to 1925°C (3500°F), combined in many cases with excellent room-temperature ductility. Particularly outstanding in this respect are alloys in the system Ta−Mo−W. (auth)

3466 (ASD-TR-61-351) THE EFFECT OF INTERSTITIAL ATOM-DISLOCATION INTERACTIONS ON THE DEFORMATION BEHAVIOR OF COLUMBIUM, TANTALUM, AND 1020 STEEL. B. A. Wilcox (Aeronautical Systems Div. Metals and Ceramics Lab., Wright-Patterson AFB, Ohio); and R. A. Huggins (Stanford Univ., Calif.). July 31, 1961. 97p. (AD-275111)

The strain-aging tendencies of arc-melted Nb and Ta, 1020 steel, and hydrogenated Nb were investigated using yield-point return and dynamic modulus of elasticity measurements to study the aging process. Comparison of activation energies for strain-aging with those for interstitial diffusion revealed that H was responsible for dislocation-locking in Nb, and probably in Ta, in the temperature ranges studied. The studies on 1020 steel reconfirmed the previously well-known fact that N and C cause dislocation-locking in mild steel, and validated the accuracy of the yield-point return and dynamic modulus techniques for studying the strain-aging process. Harper's modification of the Cottrell-Bilby analysis was applied to the dynamic modulus strain-aging data for 1020 steel, Nb, and hydrogenated Nb to determine dislocation densities in these materials. Densities so determined were compared with values obtained by etch-pitting techniques. To obtain a measure of the degree of dislocation-locking in Nb as a function of H content, the lower yield stress of electron-beam-melted Nb was measured as a function of grain size and hydrogen content. (auth)

3467 (ASD-TR-61-474) NOTCH SENSITIVITY OF REFRACTORY METALS. A. G. Imgram, Manley W. Mallett, Billy G. Koehl, Edwin S. Bartlett, and Horace R. Ogden (Battelle Memorial Inst., Columbus, Ohio). Jan. 1962. Contract AF33(616)-7604. 126p. (AD-275379)

The effects of interstitial O_2 and H_2 on the tensile and notch tensile properties of Ta and Nb were investigated. Commercially pure Ta−10W and F-48 Nb alloy were also studied. Each material and condition was evaluated both in wrought and recrystallized structural conditions. Oxygen and H_2 additions were made in a Sieverts apparatus and

were kept within solid-solubility limits. Oxygen levels considered were 500 and 1000 ppm in both Ta and Nb. Hydrogen contents of 150 and 500 ppm were selected for Ta whereas levels of 150 and 300 ppm were selected for Nb. Notched and unnotched tensile specimens were tested over a range of temperatures selected to encompass the ductile-to-brittle transition. The notch sensitivity and transition behavior of each material and condition were evaluated largely on the basis of notch-unnotch strength ratio and ductility transition. The effects of O_2 and H_2 on the tensile properties of Ta and Nb were evaluated by comparing the data of oxygenated and hydrogenated material with data determined previously for the pure Ta and Nb. (auth)

3468 (ASD-TR-62-7-675) TITANIUM DIRECTIONALITY PROGRAM. Final Technical Engineering Report, January 7, 1959–September 15, 1961. A. E. Leach (Crucible Steel Co. of America. Midland Research Lab., Penna.). Jan. 1962. Contract AF 33(600)-37938. 31p. (AD-274204)

This manufacturing process development determined techniques for strip processing to minimize high directional mechanical properties in three DOD titanium alloys. Full-scale strip processing production operations starting with 4000 pound Ti–6Al–4V, Ti–4Al–3Mo–1V, and Ti–$2\frac{1}{2}$Al–16V ingots have shown that the Ti–$2\frac{1}{2}$Al–16V alloy is almost ideally suited to strip processing, developing negligible directionality and having excellent rolling and processing characteristics. The production of Ti–$2\frac{1}{2}$Al–16V sheet by strip rolling instead of hand sheet processing will result in greater economics in production and better gage, flatness, and surface finish control. While much information was developed on strip processing the Ti–4Al–4V and Ti–4Al–3Mo–1V alloys, final directionality in these two alloys was still higher than in hand sheet product. (auth)

3469 (BM-RI-6101) COLUMBIUM–HAFNIUM BINARY ALLOYS FOR ELEVATED-TEMPERATURE SERVICE. H. R. Babitzke, G. Asai, and H. Kato (Bureau of Mines, Albany, Oreg.). Feb. 1962. 21p.

The potential of Hf–Nb alloys as structural materials for use at high temperatures was evaluated. The work was conducted to determine the properties of Hf–Nb alloys and to select the more promising ones for further improvement. Properties determined were machinability, hardness, workability, tensile strength, and oxidation resistance. Ten ingots, ranging from 100% Nb to 70 at.% Hf, were prepared and subjected to tests. The test results showed that the alloys with 33 and 50 at.% Hf were superior in workability, strength, and oxidation resistance. For the alloy series tested, the strength and hardness values increased with the increasing Hf content. Maximum values were reached with 50 at.% Hf. The oxidation resistance was poorest at 1 at.% Hf but improved with increasing Hf content through 70 at.%. Eight of the 10 ingots were fabricable at room temperature. The two remaining ingots, those with 5 and 10 at.% Hf, required hot working. (auth)

3470 (BMI-1601) THERMODYNAMICS FOR COMPATIBILITY STUDIES OF METAL-CLAD URANIUM CARBIDE. George W. Cunningham, James J. Ward, and Carl A. Alexander (Battelle Memorial Inst., Columbus, Ohio). Oct. 30, 1962. Contract W-7405-eng-92. 34p.

Thermochemical data for the carbides of molybdenum, niobium, tantalum, titanium, tungsten, uranium, and zirconium were critically reviewed, and the free energy of formation as a function of temperature was calculated for these carbides. On the basis of these data, metal claddings of niobium, tantalum, titanium, and zirconium would be expected to react with uranium carbides in the temperature range of 1000 to 2000°C. Data are insufficient to predict the behavior of molybdenum, but tungsten should not react extensively with stoichiometric UC below 1800°C. The monocarbide (UC) is the most stable of the uranium carbides in contact with the metals listed, and U_2C_3 and UC_2 would be expected to react with all the metals over the entire temperature range of 1000 to 2000°C. (auth)

3471 (BMI-X-10017) FISSION-PRODUCT RELEASE FROM FUEL-ELEMENT CLADDINGS. Quarterly Progress Report, July–September 1962. Fitz R. Winslow, Thomas S. Elleman, George G. Cocks, Josef Bugl, and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 12p. (EURAEC-468)

A fifth series of out-of-pile Xe^{133} release experiments were performed using chromium foils impregnated with a fission product concentration of 2×10^9 fission recoils per cm^2. The effects of temperature, initial specimen surface, and fission-recoil damage on the behavior of Xe^{133} release were studied. A solid fission-product diffusion couple was prepared, and the distributions of Ce^{141}, Ru^{103}, Zr^{95}, and Nb^{95} were determined. (M.C.G.)

3472 (CRGM-1081) CAN HYDROGEN PICK-UP IN ZIRCALOY BE PREVENTED? F. H. Krenz (Atomic Energy of Canada Ltd., Chalk River, Ont.). Oct. 1962. 26p. (AECL-1626)

Experimental evidence shows that there is a large effect of oxygen dissolved in water or steam on the hydrogen pick-up of zirconium alloys corroding in these media. The evidence strongly suggests, though it does not establish, that the oxygen effect is saturated at very low concentrations of oxygen—of the order of 10^{-4} volume percent. The effect is not restricted to oxygen alone but can be observed with a series of oxidizing agents. The kinetic details of hydrogen pick-up are not well enough established to suggest a mechanism for the above effect. However, thermodynamic considerations show that the driving force for hydrogen absorption in Zr alloys is small. The absorption process should be easily inhibited or even reversed, provided the proper conditions can be found. One such condition is the repression of the hydrogen concentration by excess oxygen, a condition which can be achieved only if equilibrium or near equilibrium concentrations can be established. Since the hydrogen-oxygen reactions are slow outside of the explosion limits, the desired condition requires a catalyst. NO_2 is such a catalyst and appears also to play a role in hydrogen pick-up. The nickel content of Zircaloy also appears to affect the sensitivity of the alloy to oxygen in steam or water. This suggests that other alloys may be found that are more suited than Zircaloy to the control of hydrogen pick-up by an oxidizing environment. The lowest oxygen concentrations which have so far been shown to have an effect on hydrogen pick-up are considerably higher than those required, at equilibrium, to lower the hydrogen pressure to the desired level. It is clear that equilibrium conditions have not been achieved in the experiments performed to date and that a search for such conditions should be made. (auth)

3473 (DP-749) PREPARATION AND CHARACTERIZATION OF THE POLYMORPHS OF UO_3. W. R. Cornman, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1962. Contract AT(07-2)-1. 12p.

Six polymorphs of UO_3 were prepared and were identified

by x-ray diffraction techniques. Differential thermal techniques were used to study the decompositions of the polymorphs to U_3O_8 and to investigate the modes of formation of the polymorphs from the hydrates of UO_3. (auth)

3474 (DPSPU-62-30-38) MARK VII-A FUEL SLUGS — COMPUTER SURVEILLANCE OF CRYSTALLOGRAPHIC ORIENTATION. R. S. Wood, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Nov. 1962. Contract AT(07-2)-1. 56p.

Natural uranium fuel slugs are produced by a controlled process and definite averages and standard deviations exist for x-ray diffraction data. A change in a production variable, such as heat treatment, is readily discernible through statistical quality control. Programs for the IBM 1401 computer were developed which compute the average values and 3-sigma limits for texture coefficient and G3 growth index data. This information is updated weekly and is plotted by the computer in the form of average ($\bar{X}$) and range (R) charts. Each month an exception report and a G3 index are computed. These show only those charts which had $\bar{X}$ or R factors exceeding 3-sigma limits during the month. Thus, trends are revealed in the crystallographic orientation characteristics of fuel slugs. (auth)

3475 (GAMD-2729) COATED FUELS IRRADIATION TESTS — A MATERIALS SUMMARY. W. V. Goeddel (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Oct. 10, 1961. Contract AT(04-3)-314. 20p.

A summary of the coated-fuel particles used in the HTGR fuel materials irradiation test program is presented. All fuel was fully enriched (Th, U)C_2. Pyrolytic carbon coatings were deposited in a fluidized bed. Photomicrographs are included. (M.C.G.)

3476 (HW-75125) THERMAL EXPANSION OF PLUTONIUM NITRIDE. D. F. Carroll (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 2, 1962. Contract AT(45-1)-1350. 10p.

High-temperature x-ray diffraction lattice expansion data were used to calculate the average coefficient of linear thermal expansion for PuN. Its value between 26 and 800°C is 13.80×10^{-6} $(C)^{-1}$. No phase changes were evident in the temperature interval studied. (auth)

3477 (IS-316) THE LEAD-BISMUTH EUTECTIC. Stanley J. Stachura and George Burnet (Ames Lab., Ames, Iowa). [July 7, 1961]. Contract [W-7405-eng-82]. 26p.

Available information on the liquid lead-bismuth eutectic is reviewed. A compilation of physical, thermodynamic, and nuclear properties is included. Corrosion, corrosion inhibition, and handling of the eutectic are discussed. (R.J.S.)

3478 (JPL-TR-32-297) THERMAL EXPANSION IN AIR OF CERAMIC OXIDES TO 2200°C. T. H. Nielsen and M. H. Leipold (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Oct. 30, 1962. 28p.

Thermal expansion measurements were made in an air atmosphere to 2200°C on polycrystalline single-phase ceramic oxides. Specimens were fabricated by hot-pressing, slip-casting, and isostatic pressing. Magnesium oxide was tested in both air and argon; calcium oxide, as well as magnesium aluminate, and aluminum oxide specimens were tested in air. Specimens were characterized as to purity, thermal history, apparent density, grain size, and lattice parameter. It was determined that the coefficient of thermal expansion was not affected by changes in grain size or fabrication techniques. All of the specimens tested in an air atmosphere showed weight and lattice parameter stability, whereas the magnesium oxide tested in argon did not. When tested in an air atmosphere, magnesium oxide, aluminum oxide, and magnesium aluminate spinel showed a permanent expansion with a decrease in density at temperatures well below their melting points. (auth)

3479 (LAMS-2674(Pt.II)) A CRITICAL REVIEW OF REFRACTORIES. PART II. SELECTED PROPERTIES OF GROUP 4a, -5a, AND -6a NITRIDES. Edmund K. Storms (Los Alamos Scientific Lab., N. Mex.). Sept. 1962. Contract W-7405-eng-36. 69p.

The literature concerning the Group 4a, -5a, and -6a nitrides was reviewed critically. The following properties were discussed: preparation, phase relationship, lattice parameter and structure, appearance, chemical stability, hardness, resistivity, superconductivity, thermodynamic properties, and vaporization behavior. When possible, each property has been considered in light of the range of homogeneity exhibited by these nitrides. (auth)

3480 (LAMS-2773) SOME OBSERVATIONS OF THE EFFECT OF ATMOSPHERIC HUMIDITY ON THE FLOW OF METAL POWDER. H. D. Lewis, T. J. Ready, and H. H. Hausner (Los Alamos Scientific Lab., N. Mex.). Oct. 8, 1962. Contract W-7405-eng-36. 22p.

The general investigation of process variables affecting the precision powder-rolling of refractory fuel elements led to some semiquantitative observations of the effect of atmospheric humidity on certain aspects of the powder-rolling process. This report summarizes the observations of the effects of the powder's atmospheric environment on the powder-flow characteristics and indicates the requirement that the powder's atmospheric environment be controlled in all phases of the rolling process. (auth)

3481 (NP-12198) THE TRAPPING OF ELECTRONS AND HOLES IN MIXED CRYSTALS. Technical Report 171. Nelson C. Maynard (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research). Sept. 1962. Contract AF19(604)-8483. 27p.

Electrons and holes were produced in mixed crystals of KCl-KBr and KCl-RbCl solid solution systems by irradiation with 3-Mev electrons at −190, −80, and 20°C with doses 10^5 to 10^6 rads. The optical absorption resulting from the trapping of electrons and holes was measured at −190°C to reduce bleaching. The mixed crystals of KCl-KBr and KCl-RbCl irradiated at liquid-nitrogen temperature contained F, F′, K, and V_1 centers. The F and K centers appeared at −80°C while at 20°C irradiations the F, K, and M bands were observed. Some other bands were also observed but not studied. The Mollwo relation (λ = const. d^n) is not valid for the shift of the maximum of all bands observed, possibly because of lattice distortion. The center frequency of the F′ band shifted with composition opposite to the F-band deviation. In pure crystals the center frequency of the F′ band was found to be lower than previously observed. The half-width of the F band is greater in mixed crystals – its maximum approximately corresponding to the microhardness maximum and the maximum deviation from linear of the exciton band-edge shift. The V_1 band half-width in the KCl-RbCl system decreases contrary to that in KCl-KBr. Intensity of the F band-versus-composition curves for KCl-KBr exhibit both a relative maximum and minimum, but in KCl-RbCl only a deep minimum. In no case did a mixed crystal color more than pure KBr, contrary to what might be expected from the large distortions present. Curves for the F′ and V_1 bands follow the general pattern of those of the F band but with reduced intensity. (auth)

3482 (NP-12224) THERMAL RADIATION PROPERTIES OF MATERIALS AND METHODS OF MEASURE-

MENT—A GUIDE TO THE LITERATURE. A. R. Bulls (Vought Astronautics, Div. of Chance Vought Corp., Dallas). Dec. 8, 1961. 370p. (AST/EIR-13533)

Approximately 417 references to report and published literature from sources dating from 1910 to 1961 are presented on thermal radiation properties of materials and techniques of measuring those properties. Indexes are provided for materials, subjects, and measuring methods. (R.J.S.)

3483 (NP-12253) DEVELOPMENT OF FINE DIAMETER HIGH-PURITY WIRE FROM ZONE-REFINED BERYLLIUM. Progress Report No. 3, August 1, 1962–September 30, 1962. Technical Report 285-236. A. G. Gross, Jr. and R. G. O'Rourke (Brush Beryllium Co., Cleveland). Contract NOw-62-0067-C. 32p.

A crystal of zone-refined Be (made from cast "selected pebble") was converted to 0.00407-in.-dia. wire at a very high material yield by varying the input material rather than by an alteration of processing technique. Wire made from this crystal did not exhibit any evidence of nonmetallic inclusions. It contained no evidence of nonmetallic inclusions. Room-temperature tensile strength and yield strength of the as-drawn wire from the crystal approached, at high reductions, the strength levels of commercially pure wire. The room-temperature ductility of the as-drawn wire showed some signs of being greater than that of comparable commercially pure wire. The wire was heat treated, and measurements were made by metallography, x-ray diffraction, and room-temperature tensile testing. Metallographic examination revealed that the heat treatment which was used caused appreciable grain growth. The amount of grain growth was considerably larger than would have been anticipated. (auth)

3484 (NP-12305) ENGINEERING PROPERTIES OF POTASSIUM. Quarterly Report No. 8, July 1–September 30, 1962. Alexis W. Lemmon, Jr. (Battelle Memorial Inst., Columbus, Ohio). Oct. 30, 1962. Contract NAS-5-584. 21p.

Measurements of the viscosity, vapor pressure, and heat capacity of liquid potassium have been concluded. In addition, data for the thermal conductivity and electrical resistivity have been obtained at temperatures up to about 800°C; minor modifications in the apparatus are believed needed to continue measurements to 1150°C as planned. Equipment for measuring the P-V-T properties is in the final stages of assembly, and measurements are expected to be completed during the next quarter. Effort on the design study of equipment for determining the specific heat of potassium vapor has been concluded. Study of methods and techniques for measuring the thermal conductivity of potassium vapor is nearing conclusion. (auth)

3485 (RAD-SR-62-219) MICROSTRUCTURE STUDIES OF POLYCRYSTALLINE REFRACTORY OXIDES. Quarterly Progress Report No. 1, June 12 to September 12, 1962. T. Vasilos, R. M. Spriggs, and J. Mitchell (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). Nov. 7, 1962. Contract NOw-62-0648c. 23p.

A mechanical testing machine was designed and constructed to determine the elastic modulus and modulus of rupture for transverse bending of high-density alumina and magnesia at elevated temperatures. Log-log plots of room-temperature strength (extrapolated to zero porosity) versus grain size for alumina revealed the relationship: $S = 86{,}000\ G^{-\frac{1}{2}}$ (psi) where G = grain size in μ, and $S = 50{,}000\ G^{-\frac{1}{2}}$ (psi) for heat-treated specimens of magnesia. More than 100 test specimens of dense alumina and magnesia were fabricated with fine grain microstructure (about 2 to 3 μ average size). Others are being machined from fabricated blanks, and specimens with larger grain size are being prepared by heat treating. Specimens prepared to date have an average grain size range of 2 to 130 μ. (auth)

3486 (RDB(S)TM-3303) FURTHER STUDIES OF INCLUSIONS IN URANIUM. M. D. Jepson and G. Slattery (United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England). [nd]. 7p.

Results of investigations concerning U inclusions are presented. The x-ray evidence confirms that UO_2 and UC are present in remelted U dendrites. The single-phase dendrites are probably UC and the duplex dendrites probably UO_2 and UC. Type VII inclusions were observed but not identified. Higher purity U is required for preparation of alloys to assist in identification work. (J.R.D.)

3487 (SEP-260) FUNDAMENTALS OF DIFFUSIONAL BONDING. [PART] VII. Seventh Annual Progress Report, July 1, 1961 through June 30, 1962. L. S. Castleman, H. A. Froot, and L. Seigle (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). June 30, 1962. Contract AT(30-1)-2102. 25p. (TR-62-451.2)

An investigation was completed of the growth kinetics of β-brass layers in α-brass vs γ-brass diffusion couples. It was found that useful estimates of the diffusion coefficients at the interfaces can be made from interface displacement data, and a useful estimate of the mean heat of activation for diffusion can be made from layer growth data. The effects of pressure on layer growth kinetics were explored and found to be consistent with a vacancy model for diffusion in β-brass in both the disordered and ordered temperature ranges. Preliminary work was started on investigation of multiphase diffusion in ternary systems. (auth)

3488 (TID-14175) NEUTRON DIFFRACTION STUDIES OF HIGHER CARBIDES OF HEAVY METALS. Masao Atoji (Argonne National Lab., Ill.). Sept. 1961. Contract [W-31-109-eng-38]. 7p. (UAC-5603)

The neutron diffraction and paramagnetic scattering analyses of the CaC_2 type carbides (CaC_2, YC_2, LaC_2, CeC_2, TbC_2, YbC_2, LuC_2, UC_2) and the Pu_2C_3 type carbides (La_2C_3, Ce_2C_3, Pr_2C_3, Tb_2C_3) showed strong correlations between the interatomic distances and the metal valency. These correlations and the vanishing Knight shift of YC_2 can reasonably be interpreted from the following postulations. The conduction band wave functions of MC_2 are composed only of the metal d-orbitals and the $C_2-\pi_g 2p$ antibonding orbitals. The $C_2-\pi_g 2p$ contribution to the conduction band is smaller in M_2C_3 than in MC_2. The conduction band of M_2C_3 is also associated with the metal S-orbital. (auth)

3489 (TID-14497) THE DEVELOPMENT OF HIGH PURITY TANTALUM AND ALLOYS FOR LIQUID PLUTONIUM CONTAINMENT IN LAMPRE I. Richard M. Bidwell, William E. Ferguson, Calvin C. Burwell, R. Philip Hammond, Keith V. Davidson, Walter R. Wykoff, and Robert W. Anderson (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 35p. (LADC-4969)

By combining arc casting and electron beam melting, spectroscopically pure tantalum and alloys, suitable for containment of molten Pu-Fe alloys, were produced. The 0.1% W alloy was used for the first LAMPRE loading. The effects of a large number of additives on the corrosion resistance of tantalum were tested. Additions of up to 10% tungsten gave increasing endurance. Specimens of tantalum irradiated with neutrons until 3% converted to tungsten were still satisfactory in mechanical properties for reactor use. Either tungsten or the traces of yttrium remaining after arc melting can raise the one-hour recrystallization temperature of tantalum by 400°C. Effects of internal

strain, critical strain and precipitation hardening in tantalum alloys were studied. High-temperature annealed tantalum had superior corrosion resistance, while impact extruded and ironed material was better than deep-drawn metal. Mechanical tests on tantalum with added interstitial elements showed that their presence to the extent expected in LAMPRE would be unlikely to weaken the tantalum. Evidence was found that oxygen promotes plutonium attack on tantalum. Small amounts of hydrogen, nitrogen and carbon had no effect on corrosion. (auth)

3490 (TID-14681) QUANTITATIVE INTERPRETATION OF PREFERRED ORIENTATION MEASUREMENTS. E. F. Sturcken and J. W. Croach (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Jan. 1962]. Contract AT(07-2)-1. 19p.

An orientation distribution function, $P(u,\phi)$, was synthesized from x-ray diffraction intensity measurements, I_{hkl}, normally used to plot inverse pole figures. The symbols u and ϕ specify the angles that the crystallographic axes of the grain make with the normal to the sample surface and $P(u,\phi)$ gives the number of grains oriented in each direction, (u,ϕ). $P(u,\phi)$ is obtained from a least squares fit of the I_{hkl} to an orthonormal set of spherical harmonic functions. A quantitative parameter, J, is defined from $P(u,\phi)$ as $J = (\pi/2) \int_0^1 \int_0^{\pi/2} P^2(u,\phi)\, du\, d\phi = (\pi/2) \sum_l \sum_m A_{lm}^2$ where where A_{lm} are the coefficients of the least squares fit. J is 1 for "random" orientation and increases with increasing preferred orientation. J is a measure of the deviation of $P(u,\phi)$ from uniformity and is related to statistical variance by the relationship $\sigma^2 = 4/\pi^2 (J - 1)$. The use of J to study the effects of fabrication variables on preferred orientation in uranium is discussed. (auth)

3491 (TID-17334) HEXAGONAL CLOSE-PACKED STRUCTURES IN Bi–Pb ALLOYS AND THE POLYMORPHISM OF LEAD AT HIGH PRESSURE. W. Klement, Jr. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Oct. 1962. Contracts AT(04-3)-221 and Nonr-220(30). 9p.

Lattice spacings have been obtained for the hexagonal close-packed structures in lead alloys containing 27.0 to 32.0 at.% bismuth, which were rapidly cooled from the melt. Axial ratios for these structures vary from 1.653 to 1.654. By extrapolation to pure lead of these volume/atom determinations and of some activity data, the free energy of hexagonal close-packed lead relative to the face-centered cubic form is estimated. It is suggested that the structure of the lead polymorph stable at pressures greater than 0.16 Mbar is hexagonal close-packed. (auth)

3492 (UCRL-6569) ASYMMETRICAL THERMAL STRESS DISTRIBUTION IN REACTOR FUEL TUBES. LaMar I. Deverall (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 14, 1961. Contract W-7405-eng-48. 25p.

A theoretical analysis was made of the thermal stress developed in a reactor fuel tube which has uniform internal power generation but which has convective heat transfer at the outer surface such that an unsymmetrical temperature distribution is developed. This type of problem can occur in the design of a high-temperature gas-cooled reactor such as those contemplated for nuclear ramjet and rocket propulsion use. The temperature and stress distributions for a typical fuel tube are given in detail. The method of analysis developed is also applicable to other reactor problems such as the thermal stress analysis of pressure vessels, tubular flow channels, etc. (auth)

3493 (UCRL-6655-T) THE DIFFUSION OF COBALT IN PURE ALPHA IRON. Richard J. Borg and David Y. F. Lai (California. Univ., Livermore. Lawrence Radiation Lab.). [1961]. Contract [W-7405-eng-48]. 8p.

Co^{60} was vapor plated on the polished surface of the iron specimen which is subsequently annealed in vacuo. The penetration profile was established by removing thin sections by grinding on an abrasive paper and the sample was weighed to determine the amount removed. A least-mean-squares analysis of the calculated diffusion coefficients, D_t gave the following expression: $D = D_0 \exp(-Q/RT) = 2.66 \times 10^5 \exp(-85{,}350/RT)$. That grain boundary diffusion occurred was confirmed not only by autoradiography, but also by the form of the penetration curves at the two lowest temperatures. (M.C.G.)

3494 (UCRL-6696-T) ESTIMATION OF HIGH-PRESSURE COMPRESSIBILITIES OF METALS. Stephen G. Brush (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1961. Contract [W-7405-eng-48]. 7p.

It is shown that Birch's equation for the isothermal pressure-density relation of solids enables one to estimate the high-pressure compressibility of several metals and of sodium chloride, using only the compressibility as measured at low pressures. (auth)

3495 (UCRL-9808) PRESSURE-TEMPERATURE-RESISTANCE PROPERTIES OF LANTHANUM, BISMUTH, NEPTUNIUM, PLUTONIUM, AND AMERICIUM TO 450°C AND 30kb. D. McWhan, P. W. Montgomery, H. D. Stromberg, and G. Jura (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1961. Contract W-7405-eng-48. 20p.

The actinide elements neptunium, plutonium, and americium are materials of considerable interest to the high pressure investigator. The possibility of pressure induced electronic transitions such as those in cerium and cesium is suggested by the electronic configurations of the actinides. Such transitions are usually detectable by a discontinuous change in the electrical resistance of the sample. A matter of additional interest is the known one atmosphere polymorphism of plutonium with six allotropic forms between room temperature and its melting point, of neptunium with two allotropic forms, and a suspected allotropism in americium. The program therefore involved the following: development of apparatus capable of developing high pressures and temperatures which could allow electrical resistance measurements to be made on milligram quantities of metal and was resistant to breakage or blowout which could contaminate the laboratory, permanent equipment, and laboratory personnel. (auth)

3496 (UCRL-10415) THE MECHANISM OF THE MARTENSITE BURST TRANSFORMATION IN SINGLE CRYSTALS OF IRON CONTAINING 31.7 PER CENT NICKEL (thesis). Jack C. Bokros (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 7, 1962. Contract W-7405-eng-48. 57p.

The martensite burst transformation was studied in single crystals of iron containing 31.7% nickel. It was found that the morphology of the transformation was greatly simplified in crystals that had been strained plastically prior to transformation. This simplification made possible detailed crystallographic studies of the morphology of the transformation. These studies showed that the autocatalysis responsible for the burst transformation had its origin in a mechanical stimulation (coupling) between certain variants of the habit plane that were geo-

metrically oriented such that the stress induced by transformation on one aided transformation on the others. In both strained and unstrained crystals, the most effective mechanical autocatalysis was observed to be between groups of four nearly parallel planes whose poles clustered about common (110) directions. In the transformation of strained crystals, the operation of certain of these groups was favored. These were the groups whose planes were nearly perpendicular to the active slip plane, but did not include the group whose poles clustered about the Burger's vector of the active slip system. This behavior was taken to be a consequence of the anisotropic substructure introduced during deformation. Because of the enhanced transformation by certain groups in strained crystals, the frequency of secondary coupling was low, and the regions of the crystals that were transformed through the operation of a single group of four variants of the habit plane were large. This effect was responsible for the simplification of the morphology produced in the burst transformation of strained crystals. (auth)

3497 (WADC-TR-59-603(Pt.III)) FRICTION AND WEAR AT ELEVATED TEMPERATURES. Ernest Rabinowicz and Masaya Imai (Massachusetts Inst. of Tech., Cambridge. Surface Lab.). May 1962. Contract AF33(616)-7648. 49p.

A number of substances have been examined for suitability under sliding conditions in the range from room temperature to 2000°F. Low melting metals applied as surface coatings show a peak in their friction at the melting points, unless they form an oxide with good lubricating ability. Pyrolytic boron nitride and graphite have the same friction and wear properties as do ordinary forms of these materials. A discussion is presented of how information may be obtained systematically from friction-temperature runs, and examples of the various techniques are given. (auth)

3498 (WADC-TR-59-762(Pt.IV)) ULTRA-SHORT-TIME CREEP RUPTURE. J. P. Knight, W. A. Cosby, and H. W. Leavenworth (American Machine and Foundry Co., Alexandria, Va.). Feb. 1962. Contract AF33(616)-7632. 203p.

The design, fabrication, and use of ultra-short-time creep test equipment for determining the mechanical properties of a structural refractory metal sheet (Ta-10%W alloy) at 2000, 2500, 2750, and 3000°F in an argon atmosphere and in a vacuum (3000°F only) are discussed and described. Heating of test specimens to maximum temperature was accomplished in 60 msec. Tensile loading at each temperature was accomplished prior to attaining test temperature and ½, 2.0, and 5.0 sec after attaining test temperature. A description of test apparatus, test procedures, and complete test data is given. (auth)

3499 (WADD-TR-61-181(Pt.II)) SUBSTRUCTURE AND MECHANICAL PROPERTIES OF REFRACTORY METALS. B. S. Lement, D. A. Thomas, S. Weissmann, W. S. Owen, and P. B. Hirsch (Manufacturing Labs., Inc., Cambridge, Mass.). Apr. 1962. Contract AF33(616)-6838. 273p.

Coordinated program on substructural characteristics of W, Mo, Ta, and Nb was carried out by ManLabs, M.I.T. Rutgers, U. Liverpool (Eng.) and U. Cambridge (Eng.) by means of advanced microscopic, x-ray diffraction, and mechanical testing techniques. Initial increase in hardness during recovery of heavily deformed W wire is ascribed to segregation of interstitials to dislocations and to microtwinning. Sharp drop in ductility on 1100°C anneal is attributed to rise in transition temperature to above room temperature due to increase in fiber width. Competing processes of polygonization and strain induced fiber boundary migration occur up to 1400°C. In Ta single crystals, the maximum principal strain changes from positive to negative on deforming below and above the upper yield point respectively. Binding energy between dislocations and interstitials in Ta is about 0.53 ev. For low interstitial contents, k_y increases as the dislocation density is decreased by higher annealing above recrystallization; for high interstitial contents, k_y is not affected. The activation energy for annealing-out of dislocation loops in Ta and Nb is about 3 ev. (auth)

3500 (JPRS-16059) ROENTGENOGRAPHIC INVESTIGATION OF THE RECRYSTALLIZATION PROCESSES OF THE BORIDES OF TITANIUM, ZIRCONIUM AND MOLYBDENUM, AND THE CARBIDES OF TITANIUM AND TUNGSTEN. S. S. Gorelik (C. C. Gorelik), V. P. Elyutin (Yelyutin), E. (Ye.) I. Mozzhukhin, Yu. (U.) S. Urazaliev, and V. F. Fynke. Translated from Izv. Vysshikh Uchebn. Zavedenii, 4: Tsvetn. Met., No. 4, 143-8(1962). 15p.

X-ray studies were made of the process of recrystallization of TiB_2, MoB_2, ZrB_2, TiC, WC, and Mo. The samples were surface bonded and polished by abrasion. Then the structural changes that took place in the bonded layer during heating were determined. The x-ray analyses showed washed-out lines of refractory compounds. All the compounds investigated had a definite area of homogeneity. The recrystallization apparently occurred by the displacement of entire atomic groups. (M.C.G.)

3501 SINTERING OF REFRACTORY MATERIALS AT ROOM TEMPERATURE BY HIGH PRESSURES. Peter W. Montgomery, Harold Stromberg, and George Jura (Univ. of California, Berkeley). Advan. Chem. Ser., 33: 18-25 (1961). (UCRL-9796)

The process of sintering refractory solids at room temperature by high pressures was studied, including the effect of purity, particle size, and calcining temperature. A possible mechanism for the sintering is discussed. Two applications are presented: first, the determination of spectra of solids which in general cannot be obtained because they are available only as powders; and second, squeezing out the pores of a catalyst support, which permitted determination of the rate of growth of platinum particles on an alumina support as a function of temperature. (auth)

3502 THE VOLATILITY OF THE CARBIDE AND NITRIDE OF PLUTONIUM. Francois Anselin and Rober Pascard. Compt. Rend., 255: 698-700(July 1962). (In French)

The utilization of mixed carbides of U and Pu as fuel elements for fast neutron reactors has been considered. This application can be extended to other semi-metallic combinations, such as the nitride and carbonitrides. In the present study, attention is drawn to a specific inconvenience of these fuels resulting from the volatility at reactor temperature of the carbide and nitride of Pu. (tr-auth)

3503 INFLUENCE OF MICRORELIEF ON THE SPREADING OF A LIQUID METAL ON A SOLID METALLIC SURFACE. Yu. V. Goryunov, N. V. Pertsov, B. D. Summ, and E. D. Shchukin (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 146: 638-41(Sept. 21, 1962). (In Russian)

The spreading of adsorption-active liquid metals and alloys on solid metallic surfaces is an important problem in view of the lowering of the strength of the solid by the adsorbed material. Up to now, only surface diffusion, i.e., the migration of monomolecular layers was considered. However, the characteristics of the solid surface must also be taken into account. The problem was studied by observing

the spreading of Hg on an oxide-free Zn surface. On a smooth surface, the Hg forms a 7° drop, spreading slowly according to the diffusion law: $r \sim t^{0.5}$. On the other hand, spreading on a previously etched Zn surface presented a different picture; it followed the $t^{0.3}$ law. Close consideration of the phenomenon showed that wetting, rather than two dimensional migration is responsible for this phenomenon. No drop was formed on the solid surface; the effect of gravity could be noted and the process was temperature-independent. It is not considered impossible that an ideally smooth surface cannot be wetted by a thin layer of liquid metal because the surface migration of the atoms lowers the surface energy of the solid in the area in front of the liquid phase, or, the presence of microrelief is required for wetting. (TTT)

3504 THE ELECTRICAL RESISTANCE OF POLYCRYSTALLINE GRAPHITE AS A FUNCTION OF TEMPERATURE AT PRESSURES UP TO 250,000 KG/CM^2. A. A. Semerchan, N. N. Kuzin, and L. F. Vereshchagin (Inst. of High Pressure Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 146: 803-4(Oct. 1, 1962). (In Russian)

The initial sample consisted of spectrographically pure, polycrystalline graphite having a specific electrical resistance $\rho = 26 \times 10^{-4}$ ohm-cm. The sample was heated with direct current, and voltage and current readings were taken at a fixed pressure value. The temperature of the sample was directly proportional to the power expended in the sample. Since the linear dimensions of the sample do not change with pressure from ~30,000 kg/cm^2 (except for a very small amount of compression), the change in the electrical resistance of the graphite sample is directly proportional to the change in the specific electrical resistance of the graphite. The electrical resistance of graphite at a definite pressure decreases with increasing temperature. At any definite temperature, the electrical resistance of graphite decreases with increasing pressure. The electrical resistance of graphite was investigated over a temperature range of 20 to 200°C. (TTT)

3505 THE STRUCTURE OF $UO_2(NO_3)_2 \cdot 2NO_2$. V. M. Vdovenko, D. N. Suglobov, and G. A. Romanov. Dokl. Akad. Nauk SSSR, 146: 1078-80(Oct. 11, 1962). (In Russian)

The complex compound $UO_2(NO_3)_2 \cdot 2NO_2$ was prepared by the following reaction: $UO_3 + 3N_2O_4 = UO_2(NO_3)_2 \cdot 2NO_2 + N_2O_3$. Magnetic susceptibility measurements were taken at 5 to 80°C in a magnetic field of 4100 Oe. The molar magnetic susceptibility of $UO_2(NO_3)_2 \cdot 2NO_2$ does not depend on temperature, and is equal to $+24 \times 10^{-6}$ cgsm. On subtracting the diamagnetic contributions from NO_3, NO_2, U(VI), and O^{-2}, a paramagnetic component of $+123 \times 10^{-6}$ is left, and this can be assigned to the uranyl ion. This evidence eliminates a structure for $UO_2(NO_3)_2 \cdot 2NO_2$, where the uranyl ion is surrounded by two NO_3^- groups coordinated bidentatively in the trans position, and by two NO_2 groups. Absorption band spectra were taken on $UO_2(NO_3)_2 \cdot 2NO_2$ in paraffin. These spectra were compared with the spectra of Cs $[UO_2(NO_3)_3]$, and it was concluded that the structure of $UO_2(NO_3)_2 \cdot 2NO_2$ can be described by the formula $NO^+ [UO_2(NO_3)_3]^-$. (TTT)

3506 INVESTIGATION OF THE HARDNESS OF TUNGSTEN IN THE TEMPERATURE RANGE OF 20 TO 2700°. G. S. Pisarenko and V. A. Borisenko (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian, SSR). Dopovidi Akad. Nauk Ukr. RSR, No. 8, 1053-6(1962). (In Russian)

Data are presented on the dependence of the hardness of deformed and annealed tungsten on the temperature within a temperature range of 20–2700°. It is shown that the temperature dependences of the hardness and the ultimate strength obey an exponential law and, when represented in semilogarithmic coordinates, have typical bends associated with changes in the mechanism of deformation. (auth)

3507 GALVANOMETRIC PROPERTIES OF Tb, Dy, AND Ho. K. P. Belov and S. A. Nikitin. Fiz. Metal. i Metalloved., 13: 43-8(Jan. 1962). (In Russian)

Electric and galvanometric properties of Tb, Dy, and Ho were measured at temperatures of ferromagnetic-antiferromagnetic θ_1 and antiferromagnetic-paramagnetic θ_2 transition points. A negative galvanometric maximum, resulting from pair processes, was observed near the θ_2 points and the longitudinal and transverse negative galvanometric effect maximum for Dy was found near θ_1 = 85°K. The temperature dependence of the Tb isothermal dip, (1/R) ($\Delta R/\Delta H$), exhibits a maximum at θ_1 = 224°K and θ_2 = 232°K, confirming the postulation on the presence of an antiferromagnetic state in terbium at 224 and 232°K. (tr-auth)

3508 TEXTURE AND DIMENSION CHANGES IN U SPECIMENS DURING CYCLIC THERMAL TREATMENT. S. F. Kovtun and V. S. Kogan (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved., 13: 317-19(1962). (In Russian)

Relative changes taking place in U during cyclic thermal treatment were analyzed using rolled, cast, and extruded specimens. Dimensional variation curves ($\Delta l/l$)% were constructed as functions of the number of cycles. Specimens 3.75 mm in diameter and 60 mm long were heated to 950°C and soaked for 15 min with subsequent cooling to room temperature. The treatment was performed in a vacuum 4 to 6×10^{-4} mm mercury. The temperature change was 40° per minute. A clearly visible cylindric texture with the b axis close to the rod axis was observed. A prolonged cyclic thermal treatment, passing through the α-β transformation, did not affect the texture. (R.V.J.)

3509 MAGNETIC SUSCEPTIBILITY OF RARE EARTH METALS Ho, Dy, Tb, AND Gd. V. I. Chechernikov (Moscow State Univ.). Fiz. Metal. i Metalloved., 13: 458-61 (1962). (In Russian)

The magnetic susceptibility of 99.5% pure rare metals (Ho, Dy, Tb, and Gd) was studied as a function of temperature at 300 to 1500°K. The results showed that only in Ho does magnetic susceptibility follow the Curie-Weiss law in the investigated temperature range. In the others, the susceptibility varies at high temperature. (R.V.J.)

3510 ELECTRONOGRAPHIC STUDIES OF THE STRUCTURE OF HEATED AND COOLED LIQUID METALS. B. T. Boiko, L. S. Palatnik, and N. I. Rod'kina (Khar'kov Lenin Polytechnic Inst.). Fiz. Metal. i Metalloved., 13: 555-60(1962). (In Russian)

Electronographic studies of the structure of heated and cooled tin and indium showed that at 10° the order of tin is close to the white tin crystal state, at 70° it exhibits the most dense packing. The densely packed (8 + 4) solid state of indium exhibits a reduced number of atoms in the first coordination sphere (≤8) with further losses with further heating. (tr-auth)

3511 STUDIES OF TRANSITION METAL BORIDES BY MEANS OF NUCLEAR MAGNETIC RESONANCE. O. T. Malynchkov and V. A. Povitskii (Moscow Steel Inst.). Fiz. Metal. i Metalloved., 13: 676-80(1962). (In Russian)

The nuclear magnetic resonance of B^{11} in Ti, Zr, Nb, Ta, Cr, and Mo borides exhibited first and second order quadrupole effects. The quadrupole bond constants were found

on the basis of assumptions made for the valence structure of the compounds. (tr-auth)

3512 ELECTROPHYSICAL AND X RAY STUDIES OF RARE EARTH HEXABORIDES. G. V. Samsonov, E. E. Vainshtein, and Yu. B. Paderno (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved., 13: 744-9(1962). (In Russian)

Electrophysical and x-ray spectral studies of rare earth borides revealed effective ionic charges in rare earth hexaborides, specific density of current carriers, and other interatomic interactions. (R.V.J.)

3513 STUDIES OF FILAMENT BERYLLIUM CRYSTALS. I. PREPARATION AND ORIENTATION OF WHISKER CRYSTALS. V. M. Amonenko, I. I. Papirov, G. F. Tikhinskii, and V. A. Finkel (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved., 13: 928-30(1962). (In Russian)

The parameters of whiskers formed during vapor crystallization were studied using 99.99% pure beryllium. Prepared crystals were several dozen microns in diameter and several millimeters long. The x-ray studies showed that the whiskers are not oriented in the maximum particle packing direction. (R.V.J.)

3514 INVESTIGATIONS OF CrB, LaB_6 AND B CRYSTALS BY MEANS OF NUCLEAR MAGNETIC RESONANCE. O. T. Malyuchkov and V. A. Povitskii (Moscow Steel Inst.). Fiz. Metal. i Metalloved., 13: 933-4(1962). (In Russian)

Nuclear magnetic resonance of B^{11} was observed in CrB, LaB_6, and in three pure B modifications. Specimens of CrB and LaB_6 powders with 72-μ particles and pure B pressed into bars 11 mm in diameter and 22 mm long were used. The CrB spectrum showed two satellite lines corresponding to the quadrupole perturbation for nuclei with $I = \frac{3}{2}$ spin (B^{11}). The LaB_6 crystal is an octahedral center crystal with a B octahedron. The amorphous phase in the first pure B crystal occupied 50 to 60% of the volume and α and β-rhombohedral modifications were observed in the second and third specimens. The icosahedron was the basic structural element in all four known boron modifications. Spectral variations in the boron specimens are the result of the long-range force of three-center bonds. (R.V.J.)

3515 HEAT CAPACITY AND ENTHALPY OF MOLYBDENUM IN THE TEMPERATURE INTERVAL 0 TO 2500°. V. Y. Chekhovskoi (High Temperatures Lab., Moscow). Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR, 5: No. 6, 43-7(June 1962). (In Russian)

The temperature along the height of a heater was measured by an experimental setup for the determination of enthalpy. The change of temperature in the heater in the place where the sample was located did not exceed the error of temperature measurement by a pyrometer. On the basis of experimental data, empirical equations for the calculation of heat capacity and enthalpy of molybdenum are proposed. The equations provide a good average of experimental points and experimental data of others, therefore can be recommended for application in the temperature interval 0–2400°C. (auth)

3516 GRAIN REFINEMENT OF URANIUM–CHROMIUM ALLOYS BY CONTINUOUS COOLING. D. C. Minty and B. R. Butcher (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nucl. Energy Pt. A and B, 16: 369-73(July 1962). (AERE-R-3896)

The transformation temperatures and grain sizes of dilute uranium-chromium alloys were studied as a function of cooling rate. The results suggest that an alloy could be developed which would transform from the β-phase to fine equiaxed α-grains by a non-orientation dependent mechanism, when it is cooled at rates comparable to those observed on air-cooling large bars. (auth)

3517 A HIGH TEMPERATURE CRYSTALLOGRAPHIC PHASE INVERSION IN BeO. D. K. Smith (Univ. of California, Livermore), C. F. Cline, and V. D. Frechette. J. Nucl. Mater., 6: 265-70(Aug. 1962). (In English)

The existence of a high-temperature polymorph of BeO was verified by high-temperature x-ray-diffraction methods. The high temperature pattern was indexed using a cubic cell with a = 4.76 Å. The transformation temperature is 2050 ± 25°C, and the reaction is rapidly reversible. Optical and x-ray measurements indicate that cycling through the transformation temperature will cause changes in the crystallographic orientations of grains. (auth)

3518 SUB-CRYSTAL FORMATION IN BeO CRYSTALS AT HIGH TEMPERATURE. Stanley B. Austerman (Atomics International, Canoga Park, Calif.). J. Nucl. Mater., 6: 332-3(Aug. 1962). (In English)

The phase transformation in BeO at ~2100°C is accompanied by cracking, crumbling, and fragmentation of individual grains. The grain fragmentation effect was also observed in single BeO crystals with the formation of subcrystals. The strucutres of the sub-crystals were studied. The dominant pattern of domain orientation was derived from the parent crystal orientation by a 90° rotation of the c axis about one of the $(11\bar{2}0)$ axis. The sub-crystals are grouped within regions related to each other by 60° rotation in the crystal plane (hexagonal pattern). A pattern of rectangular or square blocks was also observed. (D.L.C.)

3519 SOME ELASTIC PROPERTIES OF BeO AT ROOM TEMPERATURE. G. G. Bentle (Atomics International, Canoga Park, Calif.). J. Nucl. Mater., 6: 336-7 (Aug. 1962). (In English)

The velocity of sound waves in a large number of BeO samples was determined at room temperature and used to calculate the elastic properties of BeO. The calculated properties were Young's modulus, shear modulus, and Poisson's ratio. Measurements on three irradiated samples showed no effects of 1.4×10^8 r Co^{60} gamma rays on the elastic properties. A plot of Young's modulus vs density is given. (D.L.C.)

3520 CREEP-RUPTURE BEHAVIOR OF 1¼ Cr-¼ Mo STEEL WELDMENTS. R. G. Shepheard and M. J. Donachie, Jr. (ASTM Headquarters, Philadelphia). Mater. Res. Std., 2: 274-7(Apr. 1962). (GA-2166)

The rupture strengths of 1.25 Cr-0.5 Mo steel weldments determined in air at 1000 and 1200°F for rupture times to about 1000 hr were compared with the properties of the base metal. For rupture times to about 1000 hr, the rupture strength of the steel was not significantly affected by welding. Low ductilities were encountered when measured along a 2-in. gage length. (auth)

3521 THE EFFECT OF CREEP PRESTRAIN ON CREEP-RUPTURE PROPERTIES OF VARIABLE NOTCH SENSITIVITY Cr–Mo–V STEEL. R. M. Goldhoff (General Electric Co., Schenectady, N. Y.). Materials Res., [1: No. 1,] 26-32(Apr. 1962).

An extensive study is reported regarding notched behavior in a low alloy chromium-molybdenum-vanadium forging steel. The results of prestrain experiments are set forth. (R.J.S.)

3522 SELECTION AND FABRICATION OF NONMETALLICS—OXIDES, BERYLLIDES AND SILICIDES. John D. Latva (U. S. Air Force, Wright-Patterson AFB, Ohio). Metal Progr., 82: No. 5, 97-102; 124; 126; 128 (Nov. 1962).

The properties of refractory oxides, beryllides, and silicides are discussed with reference to possible use in structural components. Tables of physical and mechanical properties are presented for some of the more important compounds. (D.L.C.)

3523 MAGNETIC SUSCEPTIBILITY AND HYDROGEN AFFINITY OF B.C.C. ALLOYS OF Nb–Mo Nb–Re AND Mo–Re. D. W. Jones and A. D. McQuillan (Univ. of Birmingham, Eng.). Phys. Chem. Solids, 23: 1441-7(Oct. 1962). (In English)

Magnetic susceptibilities of alloys in the three binary systems were measured in the temperature range 300 to 600°K. The heat of solution of molecular hydrogen in niobium-based alloys was also determined in specimens containing 0.05 at. per cent hydrogen. The results, together with other information on related magnetic phenomena in similar alloy systems are discussed in terms of possible density of states curves for these alloys. (auth)

3524 MAGNETIC ORDERING AND THE ELECTRONIC STRUCTURE OF RARE-EARTH METALS. A. R. Mackintosh (Iowa State Univ., Ames). Phys. Rev. Letters, 9: 90-3(Aug. 1, 1962).

The effects of magnetic ordering of the localized 4f electrons in rare earth metals on the structure of the Brillouin zones in these metals, and hence on the conduction-electron characteristics, are studied by means of a magnetic-superlattice model. The model takes into account the exchange interaction between the 4f and conduction electrons, and effects of spin-orbit interactions of the 4f electrons. The model is used to study the electric resistivity of Er and Tb as functions of crystal orientation and applied magnetic field. (T.F.H.)

3525 SYNTHETIC HIGH-FIELD, HIGH-CURRENT SUPERCONDUCTOR. C. P. Bean, Margaret V. Doyle, and A. G. Pincus (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters, 9: 93-4(Aug. 1, 1962).

The preparation and superconducting properties of Vycor glass cylinders containing filaments of superconducting Hg are described. The Hg, in the normal state, is forced at 3300 atm into the glass, which has a porosity of 35%. The magnetizations and critical current densities of several samples are measured as functions of magnetic fields and preparation parameters. These synthetic systems are found to have superconducting properties similar to those of hard superconductors. (T.F.H.)

3526 PROPERTIES OF NICKEL–THORIA ALLOYS PREPARED BY THERMAL DECOMPOSITION OF THORIUM NITRATE. Richard Murphy and Nicholas J. Grant (Massachusetts Inst. of Tech., Cambridge). Powder Met., No. 10, 1-12(1962).

Dispersion-strengthened Ni–thoria alloys have been prepared by thermal decomposition of thorium nitrate on 2-5-μ Ni powder. The resultant alloys were evaluated in room-temperature tensile tests, in creep-rupture tests at 815, 982, and 1093°C, and, for thermal stability, by annealing tests (1 hr) up to 1350°C. Relatively uniform structures were produced, which gave superior high-temperature properties and structural stability to at least 1350°C. (auth)

3527 PROPERTIES OF NIOBATE HIGH-TEMPERATURE PIEZO-ELECTRIC CERAMICS. A REVIEW OF PROGRESS. R. C. Kell (General Electric Co. Ltd., Wembley, Eng.). Proc. Inst. Elec. Eng. (London), Pt. B, 109: Suppl. No. 22, 369-73(1962).

Piezo-electric ceramics based on barium titanate have found applications in transducers for vibration measurement and in the generation and detection of ultrasonic vibration, where they combine low cost with properties more advantageous than those of piezo-electric crystals such as quartz, Rochelle salt, or ammonium dihydrogen phosphate. Niobates have the further advantage that they retain their piezo-electric properties at temperatures considerably higher than the titanates. They are therefore suitable for use in vibration transducers able to operate at high temperatures and in ultrasonic generators able to operate at large amplitude, without losing their piezo-electric properties as a result of overheating. Some of the materials have a low temperature coefficient of resonant frequency and may therefore find applications in composite resonators in filter circuits. (auth)

3528 THE EFFECT OF PRESSURE ON THE ELECTRICAL RESISTANCE OF LITHIUM, SODIUM AND POTASSIUM AT LOW TEMPERATURES. J. S. Dugdale (National Research Council, Ottawa) and D. Gugan. Proc. Roy. Soc. (London), Ser. A, 270: 186-211(Nov. 13, 1962).

Measurements were made of the electrical resistivity of lithium, sodium, and potassium at temperatures between 2 and 300°K and at pressures up to 3000 atm. From the results, the ideal electrical resistivity, ρ_i, and its volume derivative were calculated as functions of temperature for conditions of constant density. It is shown that, as predicted by simple theory, there is a linear relation between the temperature and volume coefficients of ρ_i for each metal. It is concluded that the magnitude of the volume coefficient of ρ_i does not, at high temperatures at least, agree with present theoretical predictions and that the coefficient is closely connected with the high-temperature value of the thermoelectric power. (auth)

3529 THE FRICTIONAL BEHAVIOUR OF GRAPHITE. John Spreadborough (Battelle Memorial Inst., Geneva). Wear, 5: 18-30(1962). (In English)

Experiments are reported which show that packets of graphite planes roll up on rubbing the material to form small roller bearings. Electron microscope studies of a natural graphite flake demonstrated that these rollers are formed only about a stylus path over the flake; they are not observed in undeformed regions. A mechanism for graphite lubrication is suggested which involves a surface orientation of crystallites and the subsequent formation of the rollers responsible for the low friction coefficients under normal conditions. (auth)

3530 THE PHASE DIAGRAM OF THE COBALT–GADOLINIUM SYSTEM. E. M. Savitskii, V. F. Terekhova, and I. V. Burov. Zh. Neorgan. Khim., 7: 2572-4(Nov. 1962). (In Russian)

The Co–Gd alloy system was investigated throughout the whole composition range by microstructure determination methods, differential thermal analysis, and microhardness measurements. Twenty-five alloy compositions were prepared by melting the mixtures in an arc furnace. The microstructure of the specimens indicated that the solubility of Gd in Co and of Co in Gd at room temperature does not exceed 0.2 to 0.3 wt %; alloys containing 1.0% of Gd and 0.5% of Co presented large amounts of a eutectic second phase. The existence of 6 previously reported compounds, $GdCo_5$, $GdCo_4$, $GdCo_3$, $GdCo_2$, GdCo, and Gd_3Co, were confirmed together with a new compound Gd_2Co_{17} which has a trigonal crystal structure with the following parameters: a = 8.536 kX; c = 12.429 kX; and c/a = 1.456. Two eutectic mixtures were found at the Co side of the diagram together with 2 Gd-rich compounds, $CoGd_3$ and CoGd. Hardness changes showed that addition of Gd strengthened somewhat the α-Co in the solid solution range; in the 2-phase region the hardness increased with increasing $Co_{17}Gd_2$ content. Addition of Gd decreased the

specific magnetization at room temperature. The compound $Co_{17}Gd_2$ is expected to be antiferromagnetic at low temperatures. (TTT)

3531 THE PHASE DIAGRAM OF THE NIOBIUM–TUNGSTEN–ZIRCONIUM TERNARY SYSTEM. E. M. Savitskii and A. M. Zakharov. Zh. Neorgan. Khim., 7: 2575-80(Nov. 1962). (In Russian)

Although the binaries Nb–W, Nb–Zr, and W–Zr are known, there are no data available on the ternary system Nb–W–Zr and therefore the system was investigated by means of melting point determination, x-ray diffraction, and microhardness measurements, limiting the field of study to portions of the ternary system with W:Zr ratios of 4:1, 1:1, and 1:3 and examining the isothermal cross sections at 2000, 1600, and 1100°C. The peritectic and eutectic points at 2260 and 1660°C, respectively, agree well with data reported by R. F. Domagala et al. (Trans. AIME 197: 73 (1953)). W and Zr are jointly soluble in Nb in the solid state only to a limited extent; this solubility decreases strongly with temperature. The compound W_2Zr was found to be in equilibrium with the α-Nb solid solution; this compound had the highest microhardness of the system, amounting to 778 to 804 kg/mm^2 of the system. (TTT)

3532 INVESTIGATION OF THE $Bi_2O_3-WO_3-PbO$ SYSTEM. N. P. Smolyaninov and I. N. Belyaev. Zh. Neorgan. Khim., 7: 2591-5(Nov. 1962). (In Russian)

The primary crystallization diagram of the $Bi_2O_3-WO_3-PbO$ system was determined by means of visual thermal analysis, using corundum crucibles for the melting point determinations. In the $Bi_2O_3-WO_3$ binary system which was investigated from 0 to 85 % WO_3, 3 congruents were found: $3Bi_2O_3 \cdot WO_3$, $Bi_2O_3 \cdot WO_3$, and $Bi_2(WO_4)_3$ with melting points at 1011, 1064, and 842°C, respectively. The first compound forms a continuous series of solid solutions with Bi_2O_3 and $Bi_2O_3 \cdot WO_3$; the $3Bi_2O_3 \cdot WO_3 + Bi_2O_3 \cdot WO_3$ system has a minimum at 988°C and 35% WO_3. The compound $Bi_2(WO_4)_3$ forms solid solutions with $Bi_2O_3 \cdot WO_3$ with a minimum at 830°C and 71.5% WO_3; it also forms a eutectic with a melting point of 838°C containing 76.5% WO_3. In the $PbO-WO_3$ system the existence of Pb_2WO_5 and $PbWO_4$ could be established. The compounds $PbWO_4$ and WO_3 form a eutectic with a melting point of 930°C and a composition of 67.5% WO_3. In the ternary system, solid solutions of Bi_2O_3 with $3Bi_2O_3 \cdot WO_3$ occupy a large portion of the crystallization surface. Six ternary points, including 4 eutectics and 2 transition points were found. (TTT)

3533 SOUND-VELOCITY MEASUREMENTS ON ALPHA-PHASE PLUTONIUM. Henry L. Laquer (Los Alamos Scientific Lab., N. Mex.). p.157-82 of "The Metal Plutonium." Chicago, University of Chicago, 1961. (LADC-3090)

Precision sound-velocity measurements were made on an assortment of plutonium samples of varying metallurgical history. A number of the samples exhibited some internal flaws and/or directional properties. All had densities less than 99.7% of the theoretical value. If it is assumed that low density is entirely due to retained β-phase and not to voids and microcracks, the best samples would have contained about 3.8% of β-phase, and the sample of density 19.0 gm/cm^3, 44% of β-phase. However, there appears to be a clear trend in the variation of velocity with density, so that the extrapolation to x-ray density could be undertaken with considerable confidence. From a practical point of view it should be remarked that, as long as industrial-grade plutonium samples are of widely varying and frequently low density, it is more appropriate to quote a range of values for their sound velocities and elastic constants rather than a single set of numbers. Thus Young's modulus was found to range from 8.9 to 10.1×10^{11} dynes/cm^2 ($12.9 - 14.6 \times 10^6$ psi) and the torsion modulus from 3.8 to 4.3×10^{11} dynes/cm^2 ($5.5 - 6.2 \times 10^6$ psi). (auth)

3534 RADIOGRAPHY AND AUTORADIOGRAPHY OF PLUTONIUM. Dana E. Elliott and Gerold H. Tenney (Los Alamos Scientific Lab., N. Mex.). p.210-24 of "The Metal Plutonium." Chicago, University of Chicago, 1961. (LADC-2963)

The use of radiography for inspecting the internal condition of plutonium is described in detail. Because of the high physical density of plutonium and, therefore, its high absorption characteristics toward external radiation, various energies of x and gamma radiations were studied. The energies were in the range from 300 kv to 22 Mev, depending on the thickness of the specimen investigated. The results show that by selecting the right energy of radiation, satisfactory radiographic inspection of plutonium can be performed. (P.C.H.)

3535 DELTA-PRIME PLUTONIUM. R. O. Elliott and A. C. Larson (Los Alamos Scientific Lab., N. Mex.). p.265-80 of "The Metal Plutonium." Chicago, University of Chicago, 1961. (LADC-3767)

Discussion is given on how the delta-prime phase is influenced by the usual impurities in plutonium, as well as by small amounts of other alloying elements. Data are given on plutonium-rich alloys containing all the following elements, commonly found as impurities in plutonium: C, Al, Si, Cr, Mn, Fe, Co, Ni, and U. Information pertinent to plutonium-rich alloys containing Ti, V, Ce, and Th is also included. With plutonium specimens of both ordinary and high-purity, the unit-cell dimensions and thermal-expansion coefficients of the delta-prime phase were determined as well as the temperatures of the delta/delta-prime and delta-prime/epsilon transitions. (P.C.H.)

3536 A REVIEW OF THE INTERMETALLIC COMPOUNDS OF PLUTONIUM. F. H. Ellinger (Los Alamos Scientific Lab., N. Mex.). p.281-308 of "The Metal Plutonium." Chicago, University of Chicago, 1961. (LADC-2055)

An extensive review is given on crystallographic data for intermetallic compounds of plutonium. Some of the compounds described are not strictly intermetallic but were included for completeness. (P.C.H.)

Radiation Effects

Refer also to abstracts 3877, 3878, 3879, 3880, 3881, 3882, 3883, 3884, 3885, 3886, and 3896.

3537 (HW-75052) POSTIRRADIATION EVALUATION OF ZIRCALOY-2 PRESSURE TUBE FROM KER-3, PRELIMINARY REPORT. R. C. Aungst (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 25, 1962. Contract AT(45-1)-1350. 37p.

Although the KER-3 Zircaloy-2 process tube was not etched and autoclaved prior to installation, exposure to the reactor environment produced a dark gray oxide surface inside and out similar to an autoclave film. The film seems resistant to mechanical damage and to corrosion since there were no serious scratches or gall marks inside the tube from fuel movements and no areas of localized corrosion attack. Metallography revealed no increase in hydride concentration even immediately under the film at tube locations of maximum exposure. There was no recrystallization of the original 50% cold worked structure

as a result of irradiation exposure. This is in contrast to the partial recrystallization found in another Zircaloy-2 KER tube containing 65% cold work. The only metallographic effect noted was an agglomeration of second phase particles at the grain boundaries that became more pronounced with increased exposure. Room temperature burst and hardness tests on irradiated sections of the tube showed an increase in hoop strength and hardness of 5 or 6% over unirradiated control material and sections of the same tube that were exposed to temperature only. However, elongation and fracture characteristics of all the exposed specimens including the one exposed to temperature only indicated a reduction in ductility. Thus, it appears that the strength and hardness were increased by irradiation while the ductility was decreased by time-at-temperature. Ring flattening tests indicate a stiffening of the material with moderate amounts of irradiation followed by some relaxation of this effect at the maximum amount of irradiation achieved in this test. This trend is consistent at room temperature and 300°C. In conclusion it may be said that 28 months residence in the reactor did not have an adverse effect on the KER-3 process tube except for a slight loss of ductility. A protective film was formed by the reactor environment that appears resistant to mechanical damage and corrosion, and its formation did not perceptibly increase the hydrogen content. Strength, stiffness, and hardness were all slightly improved by irradiation. This may be associated with a precipitation of second phase constituents that also increases with irradiation. The 50% cold work in this material, is below the threshold value necessary to cause recrystallization to begin under the KER exposure conditions. (auth)

3538 (HW-SA-2497) FISSION-INDUCED VAPORIZATION OF UO_2 FROM A SOURCE AND SUBSEQUENT CONDENSATION ON COLLECTORS EXPOSED TO FISSION FRAGMENT BOMBARDMENT. T. K. Bierlein and B. Mastel (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 16, 1962. Contract [AT(45-1)-1350]. 13p.

Fissionable thin films of UO_2 were irradiated in vacuum opposite thin carbon collector films. Vaporization of UO_2 due to fission fragment interaction with the source film occurs. The deposit on collectors has been identified as UO_2 by electron diffraction. A 200-Å-thick layer of carbon on the source film virtually eliminates vaporization. Fission fragment damage to carbon, platinum-coated carbon, and aluminum foil collectors manifests itself in the electron microscope image as holes and tracks. The damage to collectors appears to be a complex function of the distance between fragment and the free surface of the collector and of the energy transferred to the collector. (auth)

3539 (HW-SA-2805) AUTOMATIC PROCESSING OF MECHANICAL PROPERTIES DATA. A. L. Bement (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Oct. 18, 1962]. Contract AT(45-1)-1350. 9p.

Computers are used at Hanford for the automatic processing of data resulting from the study of neutron irradiation effects on mechanical properties of structural materials. Data processing methods are described. (R.J.S.)

3540 (NP-12257) STUDY TO DETERMINE EFFECTS OF FISSION PRODUCT GAMMA RADIATION ON ELECTRONIC PARTS AND EQUIPMENT. Progress Report No. 1, March 1, 1962 – May 31, 1962. R. M. Magee (Bendix Corp. Bendix Systems Div., Ann Arbor, Mich.). June 1962. Contract NObsr-87267. 38p. (BSC-31975)

Circuit cards from the Naval Tactical Data System computer and associated equipment will be tested under gamma radiation to determine their performance in a fission product radiation environment. The circuit cards being studied and the test methods to be used are described. (auth)

3541 (TID-17211) SIGNIFICANCE OF NEUTRON SPECTRUM ON RADIATION EFFECTS STUDIES. A. D. Rossin (Argonne National Lab., Ill.). Aug. 1962. Contract W-31-109-eng-38. 40p. (UAC-6749)

The effect of neutron spectrum on damage studies of reactor materials is discussed. It is shown that damage can be measured without knowing spectra, but the neutron exposure cannot. These arguments made use of an energy-dependent damage cross section, which says that damage is proportional to the energy available in the collision between the neutron and the lattice atom. Studies are presented of the neutron flux spectra of CP-5 and EBR-I and the effects of neutron radiation on SA 212B carbon steel. Nickel foil activation results are presented along with activation cross sections for other threshold detectors. (N.W.R.)

3542 (TID-17351) THE EFFECT OF RADIATION ON THE MECHANICAL PROPERTIES OF POLYMERS. Bibliography, Unclassified Literature, 1955 to September 1962. R. K. Traegér (New Mexico. Univ., Albuquerque, Engineering Experiment Station). Sept. 1962. For Sandia Corp., Albuquerque, N. Mex.). Contract [AT(29-1)-789]. 59p. (SCDC-2911)

The unclassified literature of radiation effects on the mechanical properties of polymers is reviewed. Neutron, gamma-ray, x-ray, electron, ultraviolet, and mixed (pile) radiation beams are considered. The bibliography is divided according to the various polymer types. Therefore one reference may be listed in several places. Sources which give data for many systems are put under one separate heading. Books containing data of radiation effects on mechanical properties of polymers are listed. A final division is made of radiation effects on the dynamic mechanical properties; an area of special interest to the author. Approximately 294 different sources are listed. The majority of the bibliography was obtained from Chemical Abstracts (1955 to June, 1960), Nuclear Science Abstracts (1957 through August, 1962), and the Engineering Index (1955 through 1961). The Physics Abstracts, Chemical Titles, and U. S. Government Research Reports were examined for the period of 1960 to September, 1962. Chemical Contents and the International Aerospace Abstracts of 1961 to September, 1962 were also checked. No attempt was made to analyze the data. (auth)

3543 (VDIT-16(2.3)) RADIATION EFFECTS ON SOLID, URANIUM BASED NUCLEAR FUEL MATERIALS. Vol. 2, No. 3. A Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Oct. 1962. 77p.

A total of 62 references are given on effects of radiation on U and U-based reactor fuel materials including alloys, ceramic oxides, refractory materials, and dispersions. Author and report number indexes are provided. (R.J.S.)

3544 (NP-tr-926) THE INFLUENCE OF GAMMA RAYS ON THE QUALITY OF CERTAIN TYPES OF FLOUR. M. Blinc. Translated by P. Glover (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Brot Gebaeck, 13: 205-9(1959). 11p.

Very poor flour types from three Italian wheat varieties were exposed to gamma radiation. Organoleptic examination of the bread as well as the estimation of some of the physical properties of the crumb, dough, bread yield, and

volume led to the conclusion that dosages of 30,000 rep for flour type Autonomia and 50,000 rep for San Pastore and Fortunato are appropriate. (R.J.S.)

3545 EFFECT OF RADIATION ON THE SURFACES OF SOLIDS. I. ANALYSIS OF ADSORPTION ISOTHERMS TO OBTAIN SITE ENERGY DISTRIBUTIONS. Arthur W. Adamson and Irene Ling (Univ. of Southern California, Los Angeles). Advan. Chem. Ser., 33: 51-61(1961).

A method is described whereby the site energy distribution function, f(Q), may be obtained from an experimental adsorption isotherm, Θ (P,T) and an arbitrarily assumed local isotherm function, θ (Q,P,T). As the method is graphical, it is not necessary to represent either Θ or θ analytically, and successive approximations are used. The method is first applied to a synthetic isotherm calculated from an assumed site energy distribution with θ taken to be the Langmuir function, to show that the original distribution is indeed regenerated. On treating various systems for which literature data are available, very similar site energy distributions result if θ is taken to be either the simple Langmuir equation or one with lateral interaction included. The distributions are temperature-independent, and are consistent with isosteric and differential heats of adsorption. (auth)

3546 EFFECT OF RADIATION ON THE SURFACES OF SOLIDS. II. CHANGES IN SPECIFIC SURFACE AREAS AND SITE ENERGY DISTRIBUTIONS. Arthur W. Adamson, Irene Ling, and Sunil K. Datta (Univ. of Southern California, Los Angeles). Advan. Chem. Ser., 33: 62-71(1961).

An investigation has been made of the effects of reactor neutrons, fuel rod and Co^{60} γ rays, and Cu x rays on the surface properties of such solids as TiO_2 (rutile), silica sand, various carbon blacks, and asbestos. The surface properties involved consisted of specific surface area determinations by low-temperature N_2 adsorption, and site energy distributions obtained by low temperature and very low-pressure N_2 adsorption. These solids are fairly insensitive to radiation, with the principal exception of x irradiation of TiO_2 which leads to considerable reduction in surface area. The site energy distribution obtained from adsorption in the submonolayer region of the isotherm before and after irradiation showed a considerable migration of sites from high to low energies. A possible explanation for the special sensitivity of TiO_2 is discussed. (auth)

3547 THE BEHAVIOR OF FISSION PRODUCTS CAPTURED IN GRAPHITE POWDER BY NUCLEAR RECOIL. V. EFFECT OF FISSION FRAGMENT DAMAGE ON THE DIFFUSION OF THE FISSION PRODUCT XENON. Seishi Yajima, Sumio Ichiba, Kazumi Iwamoto, and Koreyuki Shiba (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 35: 1263-8(Aug. 1962). (In English)

Diffusion experiments on Xe^{133} and Xe^{135} captured in natural and artificial graphite were carried out over an extensive range of fission product concentrations. The results show that the diffusion behavior of xenon in graphite is more strongly affected by fission fragment damage than by neutron damage. The effects of varying conditions on the diffusion were studied. (D.L.C.)

3548 ON THE NEUTRON RADIATION EFFECTS ON THE ELASTICITY MODULUS AND INTRINSIC FRICTION IN COPPER. A. I. Lakharov. Fiz. Metal. i Metalloved., 13: 241-7(1962). (In Russian)

A resonance method was used in the investigation of neutron radiation effects on elasticity and internal friction in copper. An increase of the elasticity modulus, reduced friction, and a shift of the amplitude dependence threshold in the intrinsic friction towards larger bent oscillation amplitudes were observed following irradiation. Radiation effects disappear during annealing at recrystallization temperatures. (tr-auth)

3549 EFFECTS OF C ON PROPERTIES OF NEUTRON IRRADIATED STEEL. Sh. Sh. Ibragimov. Fiz. Metal. i Metalloved., 13: 755-9(1962). (In Russian)

Effects of fast neutrons of Fe and Fe alloys with various C contents were studied. Variations in Fe and complex steels (resistant to thermal treatment following irradiation) are identical at 320 to 380°C. The properties of carbon steel differ considerably from Fe after irradiation as a result of defects and structural changes. (tr-auth)

3550 THE EFFECT OF NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF ZIRCONIUM–2.5% NIOBIUM ALLOY. C. R. Cupp (International Nickel Co. of Canada Ltd., [Chalk River, Ont.]). J. Nucl. Mater., 6: 241-55(Aug. 1962). (In English)

The effects of some heat treatments on the hardness of Zr–2.5 wt % Nb, and the effects of neutron irradiation at 50°C and at 250°C on its tensile and impact properties are described. Post-irradiation damage recovery data are also presented. It is concluded that the alloy's mechanical properties both before and after irradiation are significantly better than those of the Zircaloys. The heat-treated Zr–Nb alloy appears to be metallurgically stable under irradiation. (auth)

3551 A PROPOS OF "X-RAY DIFFRACTION STUDIES OF IRRADIATED BeO". B. S. Hickman, T. M. Sabine, and R. A. Coyle. AN ESTIMATION OF INTERNAL STRESSES IN IRRADIATED BeO. S. C. Carniglia (Atomics International, Canoga Park, Calif.). J. Nucl. Mater., 6: 330-1(Aug. 1962). (In English)

The paper of Hickman et al. on irradiated BeO is discussed. The bicrystal model of Hickman et al. for grain boundary failure is treated with emphasis on the junction plane. It is concluded from the treatment that irradiation of BeO to failure will be temperature-dependent to the extent that the unrestrained $\Delta c/c$ is also temperature-dependent, and will be approximately linearly dependent on the average grain size of the material. (D.L.C.)

3552 RADIATION DAMAGES ON $BaTiO_3$ SINGLE CRYSTAL. Shigeru Hayakawa, and Hiroshi Ikushima (Matsushita Electric Industrial Co., Ltd., Osaka). J. Phys. Soc. Japan, 17: 1198-9(July 1962). (In English)

Some interesting properties of gamma irradiated $BaTiO_3$ single crystals are reported. The observation of D-E loops and measurement of electrical conductivity were made on samples of various thicknesses at room temperature in air. These samples were exposed to a Co^{60} source of 100 curies. (W.D.M.)

3553 NEUTRON IRRADIATION OF ZENER DIODES. J. K. D. Verma (Saha Inst. of Nuclear Physics, Calcutta). J. Phys. Soc. Japan, 17: 1203(July 1962). (In English)

The effect of neutron irradiation on the breakdown of silicon p-n junction was investigated and are reported. The p-n junctions were that of Zener diodes and were bombarded with 14-Mev neutrons from a Cockcroft-Walton accelerator. Measurements were made at 20°C. A typical Zener diode characteristic curve before and immediately after neutron bombardment (10^{10} nvt) is shown. (W.D.M.)

3554 RADIATION EFFECTS IN NONFISSIONABLE ALLOYS. Arthur C. Damask (Brookhaven National Lab., Upton, N. Y.). Nucleonics, 20: No. 7, 43-6(July 1962).

The precipitation and solution of phases and the vacancy diffusion rates in metals are affected by radiation. These effects are reviewed, and the mechanisms (electron and

atomic displacement and thermal and displacement spikes) responsible for the effects are examined. (T.F.H.)

3555 RADIATION EFFECTS IN SEMICONDUCTORS. Gunther Wertheim (Bell Telephone Labs., Murray Hill, N. J.). Nucleonics, 20: No. 7, 47-50(July 1962).

Ionization and displacement effects of radiation on semiconductors are summarized. Both temporary and permanent effects are considered. The influence of radiation on resistivities and charge-carrier lifetimes is examined. (T.F.H.)

3556 RADIATION EFFECTS IN SEMICONDUCTOR DEVICES. James W. Easley (Sandia Corp., Albuquerque, N. Mex.). Nucleonics, 20: No. 7, 51-6(July 1962).

Displacement, ionization, and surface effects of radiation on the behavior of semiconductor devices are reviewed. Attention is given to diodes, solar cells, transistors, rectifiers, and junctions. Both transient and permanent effects are considered. (T.F.H.)

3557 EFFECT OF IRRADIATION ON LIQUID SCINTILLATORS. William R. Anderson and Isadore B. Berlman (Argonne National Lab., Ill.). Nucleonics, 20: No. 7, 62; 64; 66(July 1962).

Gamma radiation effects on the luminescence efficiency of scintillating solutions of 2,5-diphenyoxazole (PPO) in p-xylene are measured. The irradiations of the xylene are carried out prior to the addition of the PPO. The decrease in luminescence efficiency is found to be largely or entirely accounted for by the decrease in transparency of the solution upon irradiation and by the quenching of the excited solvent and scintillator molecules by radiation-produced molecules. (T.F.H.)

3558 FAST NEUTRON DAMAGE AT THE SURFACE OF METAL OXIDES. H. B. Charman and R. M. Dell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Chem. Solids, 23: 1567-70(Nov. 1962). (In English)

An experimental study was made of the chemisorption of oxygen and hydrogen on samples of nickel oxide and magnesium oxide preirradiated under vacuum in a nuclear reactor. The irradiation damage induced in the oxides by fast neutron bombardment resulted in an enhancement of the chemisorption. Calculation of the number of displacements produced in the surface region of the oxide lattice led to values of the same order of magnitude as the observed number of gas atoms chemisorbed. (auth)

3559 COLOUR CENTRES AND THERMAL BLEACHING OF SODIUM CHLORIDE AND LITHIUM FLUORIDE. K. V. Rao and J. Sharma (Indian Inst. of Tech., Kharagpur, India). Physica, 28: 653-60(July 1962). (In English)

The thermoluminescence light output at different stages of thermal bleaching and the corresponding changes in color centers, were investigated in the case of sodium chloride and lithium fluoride crystals, colored at room temperature by x rays. In the case of colored sodium chloride, during the first stage of thermal bleaching up to about 100°C, the F band decreased in intensity giving thermoluminescence and also produced another band at 580 mμ. The band seemed to be due to aggregates of F centers and was found to be responsible for the thermoluminescence emission at temperatures above 200°C. The thermal bleaching of colored lithium fluoride was found to occur roughly in three stages. The thermoluminescence light output given out by the colored crystal when heated to 180°C was due to the partial destruction of F-, colloid- and R_1 and R_2 bands. In the region from 180 to 340°C the largest light output was observed and was mostly due to the bleaching of M and F centers. In the final stage of bleaching from 340 to 380°C, a large amount of light was given out due to destruction of the F band and colloid centers. The results of the present investigation suggest that the emission bands at 519 mμ and 416 mμ observed in the thermoluminescence of sodium chloride are due to radiative recombination of holes with the electrons trapped at F and aggregate centers, respectively. Measurements on lithium fluoride crystals indicate that four different color centers are involved in the emission process; thus the variation in the spectral composition of the emission during thermoluminescence is likely to be due to the corresponding emission bands. (auth)

3560 RADIATION-EFFECTS CONSIDERATIONS IN THE DESIGN OF ELECTRONIC CIRCUIT PACKAGING FOR NUCLEAR-POWERED VEHICLES. J. H. Levine (General Dynamics/Fort Worth, Tex.). [Preprint No.] FZM-2266. Prepublication Copy. 35p.

The radiation-effects problems in designing electronic circuit packaging as associated with nuclear-powered vehicles are discussed along with methods of analyzing and solving these problems. Transient, permanent, and special radiation effects are described and examples given. Transient-effects problems associated with phototubes and dielectrics are described. Permanent-effects problems in various packaging materials are described and examples given. Special effects include gas evolution, nuclear heating, air ionization, and electromagnetic wave attenuation. These phenomena are described briefly to emphasize the need for recognition of these special effects. Four alternatives in packaging design for nuclear-powered vehicles are discussed: (1) critical material and component replacement, (2) relocation, (3) shielding of the nuclear source, and (4) local shielding. The influence of these alternatives in "design tradeoffs" are described. The role of information retrieval in the radiation-effects field is emphasized, and two radiation-effects information retrieval systems are described. (auth)

3561 TREATMENT OF ARTICLES FORMED FROM LINEAR POLYMERIZATION OR POLYCONDENSATION PRODUCTS. Victor Emanuel Gonsalves (to American Enka Corp.). U. S. Patent 3,061,530. Oct. 30, 1962.

Methods for and results of irradiation of articles are set forth. Shrinking tension and strength are decreased by the action of ionizing radiation. (R.J.S.)

PHYSICS

General and Miscellaneous

Refer also to abstracts 2725, 2738, and 2787.

3562 (AD-273540) LABORATORY PROCEDURES; ION AUGMENTATION EXPERIMENTS. A. O. Kresse and P. J. Doody (Bendix Corp. Bendix Systems Div., Ann Arbor, Mich.). Feb. 9, 1962. Contract AF04(694)-26. 75p. (BSC-29556)

The conduct of the experimental analysis of electron seeding techniques is described. The experimental techniques used are clarified and the mathematical procedures necessary for analysis and interpretation of the data are described. The experiments are twofold: first, quantitative empirical definition of the performance of electron augmenters, both ablative and rocket motor types, when subjected to a range of conditions which will affect their performance; second, an estimate of the important processes and their rates which determine the rate of electron disappearance in flow subsequent to their generation. (auth)

3563 (AFCRL-62-55) GRAPHS OF THE REAL AND IMAGINARY PARTS OF THE EFFECTIVE COLLISION FREQUENCY FOR WEAKLY IONIZED AIR. Scientific Report No. 1. Paul Molmud (Space Technology Labs., Inc., Redondo Beach, Calif.). Jan. 1962. Contract AF 19(604)-8844. 16p. (AD-273650)

Graphs of the real and imaginary parts of the effective collision frequency for air are presented. The propagation constants for an electromagnetic wave propagating in ionized air with a static magnetic field are presented in terms of these effective collision frequencies. A numerical example illustrating the use of these graphs is presented. (auth)

3564 (AFCRL-62-142) INVESTIGATION OF CARRIER INJECTION ELECTROLUMINESCENCE. Semiannual Scientific Report No. 1, October 15, 1961–January 15, 1962. A. G. Fischer and A. S. Mason (David Sarnoff Research Center, Princeton, N. J.). Feb. 15, 1962. Contract AF19(604)-8018. 49p. (AD-274948)

Electroluminescence in ZnS-type powders occurs in the interior of the particles and is confined to sharp lines of various shape. The brightness of single lines rises exponentially with voltage and becomes linear at highest voltages. Light is emitted at that end of a line which is pointed toward the electrode becoming positive. Existing theories are shown to be insufficient. A new model based on alternating bipolar field-emission from conducting imperfection lines in insulators with traps was developed and compared with experience. Good agreement with most experimental facts is demonstrated. The brightness of single lines (100,000 ft-lamberts) should be obtainable in larger areas with dc injection EL in single crystals since the working mechanism is similar. New insights were gained into the mechanism of depreciation of EL cells. The particle-size-dependence of brightness can be explained. Contact-, dc- and photoelectroluminescence can be interpreted under one common veiwpoint. (auth)

3565 (AFCRL-62-255) ATMOSPHERIC EXCITATIONS PRODUCED BY FAST ELECTRONS (thesis). Scientific Report No. 4. Richard Earl Payne (Maryland. Univ., College Park). Feb. 1962. Contract AF19(604)-3861. 42p. (AD-274250)

Experiments are described which were undertaken to determine the spectra produced by electrons with energies of less than 150 ev when colliding with air molecules. From these spectra are calculated absolute intensities of the spectral lines and an estimate of the efficiency of the electrons in producing photons. A beam of electrons of energies varying from 50 to 150 ev was used to excite and ionize gas molecules and ions in a vacuum bell jar at pressures of 5 times 10 to the minus 4 to 5 times 10 to the minus 2 mm of mercury. The light resulting from the deexcitation and recombination was focused on the entrance slit of a Jarrell-Ash two-meter spectrometer by a system of two lenses. Photographs were taken of the spectrum in the wavelength range 3500 to 6000 A and the wavelengths of the spectral lines determined. (auth)

3566 (AFCRL-62-419) ELECTRON ATTACHMENT OF SeF_6. Scientific Report No. 3. F. N. Mastrup (Space Technology Labs., Inc. Physical Electronics Lab., Canoga Park, Calif.). [1961]. Contract AF 19(604)-7985. 32p. (AD 274272)

During recent years, formation of negative ions has received considerable attention because of its intimate relationship to atmospheric physics and to some plasmas of low and moderate temperatures. Experimental results recently obtained in a laboratory study on the formation of negative ions of SeF_6 by collisions with electrons having energies in the range from 0.1 to 1.5 ev are discussed. This analysis deals with attachment through two-body collisions. (auth)

3567 (AFCRL-851) THE FORMATION OF IONS IN THE UPPER ATMOSPHERE. GRD Research Notes No. 66. Robert E. Huffman (Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.). Nov. 1961. 34p. (AD-273999)

The present state of knowledge concerning the formation of positive and negative ions in the earth's normal ionosphere is reviewed. The main process by which positive ions and electrons are formed in the ionosphere is photoionization of neutral constituents by solar vacuum ultraviolet radiation. Negative ions are formed primarily by direct attachment of electrons to certain neutral constituents. Existing values of the cross sections and rate coefficients of these processes are presented and gaps in the present knowledge are discussed. (auth)

3568 (ANL-6592) CRYSTAL GEOMETRY COMPUTER PROGRAM. Lawrence P. Bush and Lowell T. Lloyd (Argonne National Lab., Ill.). Oct. 1962. Contract W-31-109-eng-38. 17p.

A program which calculates various relationships of crystal geometry was prepared in FORTRAN notation for use with the IBM-704 computer. The primary outputs are the angles between planes, and the angles between directions, that are required to construct standard stereographic projections for any of the seven crystal systems. Values are tabulated for interplanar spacing, area of the unit parallelogram on a lattice plane, and the distance between identical points along a lattice direction. The relations can be evaluated for permutations of Miller indices whose absolute values are less than or equal to 22. Redundant indices are omitted from the output. (auth)

3569 (ASD-TDR-62-707) STUDY OF ELECTRICAL AND PHYSICAL CHARACTERISTICS OF SECONDARY EMITTING SURFACES. W. T. Peria, ed. (Minnesota. Univ., Minneapolis). July 3, 1962. Contract AF33(616)-6239. 188p.

Some of the techniques in general usage in this laboratory are described. The results of completed investigations on the influence of a cesium overlayer on the stability of the secondary yield of MgO films, on the optimum oxidation conditions for Mg-Ag alloy, and on the "depth of color" due to electron bombardment of MgO crystals are presented. Some data obtained on MgO and Al_2O_3 films by the application of recently developed techniques are presented, as are the measurements of the reflection and transmission yield of one unbacked MgO film. Progress in the studies of the dissociation of compounds by electron bombardment, and of the dependence of the secondary yield on the angle of incidence of the primary beam is reported. Preliminary results of a slow-electron diffraction study of a MgO surface are given and several aspects of the theory of secondary electron emission are treated. (auth)

3570 (ASD-TR-61-723) FEASIBILITY OF THE USE OF HOLLOW CATHODES FOR THERMIONIC ENERGY CONVERSION. I. Brodie and A. Niewold (Westinghouse Electric Corp. Electronic Tube Div., Elmira, N. Y.). Nov. 30, 1961. Contract AF33(616)-7912. 48p.

Theoretical and experimental studies are reported to determine the feasibility of applying "electron blackbodies" to thermionic energy conversion. The conclusion from this work is that the size of the effusing hole is governed largely, not by the size of the cavity to which it is the exit, but by the physical limitations imposed by the nature of the electron atmosphere within the cavity. It is shown that the density of the electron atmosphere within the cavity is only large in a region close to the surface of the emitting walls and may be characterized by a parameter d, which does not depend on the size of the cavity. A quantitative expression is given for the conditions under which the effusing hole behaves as an electron blackbody. It is shown that for the electron emission density to be large enough for useful thermionic energy conversion, the size of the effusing hole has to be too small for practical consideration. (auth)

3571 (IA-771) ETUDE DE LA DECOMPOSITION DE CO_2 SOUS L'EFFET DE LA DECHARGE SILENCIEUSE (thèse). (The Decomposition of Carbon Dioxide by Electrical Discharge (thesis)). M. Faraggi (Israel. Atomic Energy Commission, Rehovoth). Sept. 1962. 108p.

The decomposition by silent discharge of CO_2 and of mixtures of CO_2 with small quantities of CO, O_2, and NO_2 was studied at ambient temperature and pressure as a function of electrical energy and residence time in the discharge. The decomposition products were CO, O_2, and O_3 in constant ratio. The G[CO] values varied between 5.8 and 0.5. The mechanism of the chemical reactions is given. The interaction between electrons and CO_2 molecules appears to proceed by two mechanisms – successive excitations and ionization. (auth)

3572 (LAMS-2770) RISE THROUGH THE ATMOSPHERE OF A HOT BUBBLE. Francis H. Harlow and Billy D. Meixner (Los Alamos Scientific Lab., N. Mex.). Oct. 1962. Contract W-7405-eng-36. 16p.

The Particle-in-Cell method for multidimensional fluid-dynamics calculations was used on the IBM Stretch Computer to study the motion of a hot gas bubble created by a nuclear explosion in the earth's atmosphere. In the example, a total energy of 8.24×10^{20} ergs was deposited at an altitude of 95 km. After 2.85 sec the originally-heated air was moving upwards with a mass-averaged velocity of 3.5 km/sec and was still accelerating somewhat, probably to an asymptotic value of 4.0 km/sec. Along the cylindrical axis at 2.85 sec, the upwards velocities varied from 0.0 km/sec at the bottom to 5.8 km/sec at the top; most of the central material was moving at velocities greater than 4.0 km/sec. Details concerning bubble shape, energy histories, and shock configurations are also included. (auth)

3573 (NP-12206) THERMAL RADIATION GUIDES FOR POWER TRANSMISSION. Quarterly Progress Report No. 1, July 1 – September 30, 1962. W. J. Swenson (Electro-Optical Systems, Inc., Pasadena, Calif.). Oct. 15, 1962. Contract AF33(657)-8526. 37p. (EOS-3000-Q-2).

Progress in the development of thermal radiation focusing guides for power transmission is reported. Thermodynamic analyses that will lead to the development of equations assisting in the determination of optimum guide configurations and materials for applications are introduced and discussed. The fabrication of the guides by electrofining techniques is discussed along with the possibility of using other fabrication techniques. The feasibility of using radiation guides to supply power to two energy absorbers (the laser and thermionic diode) is discussed. Prototype radiation guide tests show good power transmission efficiencies. Factors entering into optimum guide dimensions are discussed. (N.W.R.)

3574 (NP-12212) PROJECT SQUID SEMI-ANNUAL PROGRESS REPORT, APRIL 1, 1962 TO SEPTEMBER 30, 1962. (Princeton Univ., N. J. Forrestal Research Center). Oct. 1, 1962. Contract Nonr 1858(25). 102p.

Studies concerning extension of theoretical and experimental methods for analysis of problems involving nonsteady and/or nonequilibrium flows are reported. Activities during the period were concerned with various aspects of flows in which a uniformly dispersed cloud of solid particles is carried along by a perfect gas. Propagation of shock waves and other waves through such suspension is being analyzed theoretically. Other research is described on transport and transfer processes and the chemical kinetics of O_2 – Mg vapor reactions. Work is also reported on hydrazine decomposition in shock tubes, dynamics of free radical reactions, inelastic molecular collisions, solid propellant combustion mechanisms, development of apparatus for measuring thermal conductivity of CO_2 and other gases at 1000 to 1800°K, analysis of plasma phenomena in magnetohydrodynamic propulsion, and measurement of enthalpy fluctuations as a function of time and space in high-temperature gases. Investigations are also reported on burning characteristics of high-energy fuels and expansion in plasma jets. (J.R.D.)

3575 (NP-12312) AN INVESTIGATION OF THERMAL FORCE WITH PARTICULAR REFERENCE TO MATERIALS OF HIGH THERMAL CONDUCTIVITY. Final Report, January 1, 1959 through June 30, 1961. Thomas W. Wilson, J. Andrew McAlister, and Clyde Orr, Jr. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). 157p.

An experimental investigation of thermal precipitation and of gas-suspended particulate behavior under the influence of a temperature gradient was undertaken in an effort to reconcile conflicts reported from previous studies, specifically those observed with aerosolized solids of high thermal conductivity. An interpretation of results, based on the use of an effective particulate thermal conductivity lower than that of the solid due to agglomeration, permits the qualitative correlation of experimental results with Epstein's theory and provides an explanation of superficial inconsistencies in experimental data. (auth)

3576 (ORNL-TM-399) A FACILITY OF HIGH THERMAL NEUTRON FLUX IN THE ABSENCE OF FAST NEUTRONS AND GAMMA RAYS. R. van der Walt and A. L.

Colomb (Oak Ridge National Lab., Tenn.). Oct. 17, 1962. Contract [W-7405-eng-26]. 14p.

A facility capable of yielding a high thermal neutron flux in the absence of fast neutrons and gamma rays was studied. This facility, if used with a 1-Mw pool-type reactor, will yield a thermal flux of 9×10^{11} n·cm^{-2}·sec^{-1}; a thermal flux to fast neutron dose ratio of 4×10^{11} n·cm^{-2}·rem^{-1}; a 0 → 10 kev flux to 10 kev → 10 Mev neutron dose ratio of 9×10^{12} n·cm^{-2}·rem^{-1}; and a thermal flux to gamma dose ratio of 2.9×10^{11} n·cm^{-2}·rad^{-1}. These results were obtained using the Twenty Grand Code to compute the fast and thermal neutron flux distributions and the Nightmare Code to calculate the gamma dose rates. (auth)

3577 (TID-17067) SOLID STATE INVESTIGATIONS UTILIZING ELECTRON-BOMBARDMENT PHENOMENA. Annual Progress Report for 1962. Martin A. Pomerantz (Bartol Research Foundation, Swarthmore, Penna.). Contract AT(30-1)-2730. 62p.

The 2-Mev electrostatic generator and the 1.5 Mev linear accelerator were used in the program during the year. Improvements in these machines were effected which resulted in a faster rate of data production. The energy scale of the Van de Graaff generator was calibrated. Research on bombardment-induced conductivity in diamonds is reported. Data are included on electric conductivity changes in crystals. Parallel work on MgO crystals is reviewed. Other investigations were concerned with the radiation effects of relativistic electrons on the yield point of several metals. Theoretical investigations were conducted on the thermally-activated polaron motion, post-bombardment conductivity, secondary electron emission, and spin deviation theory of ferromagnetism. (J.R.D.)

3578 (TID-17168) KINETIC AND POTENTIAL CORRELATION ENERGY. Tadashi Arai and Peter Lykos (Argonne National Lab., Ill.). [1962]. Contract [W-31-109-eng-38]. 5p. (UAC-6810(Pt.2))

The magnitude of the one-center electron repulsion integral ($1/r_{12}$) for a doubly-occupied conjugated hydrocarbon atomic pi-orbital is discussed. The difference between the theoretical and empirical values is attributed to the correlation energy associated with the two-pi-electron system. The correlation error is distributed among the various energy terms contributing to the total energy and is by no means confined to the electron repulsion term. The correlation energy is defined as the difference between the ground state Hartree-Fock solution and the lowest eigenvalue of the same Hamiltonian operator. The correlation energy may also be divided into the kinetic and potential energy parts. According to the virial theorem, the kinetic energy is exactly equal to minus one-half the potential energy. Since both the exact and Hartree-Fock solutions satisfy the virial theorem, the kinetic energy contribution to the correlation energy is exactly equal to minus the correlation energy. The helium atom in its non-relativistic ground state is used to illustrate the correlation energy conditions. Comparison of several ways of estimating electron repulsion in helium is given. (N.W.R.)

3579 (TID-17295) THE SPECTRUM, THE EXCITATION AND IONIZATION CROSS-SECTIONS FOR PHOTO PROCESSES AND FOR COLLISIONS, OR FIVE TIMES IONIZED OXYGEN. Fifth Quarterly Report, June 1, 1962–August 31, 1962. Carlos M. Varsavsky (P.E.C. Corp., Boulder, Colo.). Contract AT(11-1)-1017. 16p.

The preparation of computer programs for the computation of the photoionization cross section, a_ν, of oxygen five-times ionized from the ground level is described. A discussion is presented of the two mechanisms by which further ionization of O^{5+} will be produced, photoionization and collisional ionization by electron impact. It is shown that in collisional ionization the recombination coefficient, a_ν, can be derived directly from the photoionization cross section. The available data on values of a_ν and work now in progress are briefly reviewed. A method for calculating a_ν, using a screening method for the calculation of the effective nuclear charge for nonhydrogenic atoms or ions, is suggested. A brief comparison is made of preliminary results with previous calculations. (H.D.R.)

3580 (UCRL-6400) THEORIES OF LIQUID VISCOSITY. Stephen G. Brush (California. Univ., Livermore. Lawrence Radiation Lab.). June 30, 1961. Contract W-7405-eng-48. 109p.

Attention is given to basic principles of current theories of liquid viscosity, such as the fluctuation-dissipation theory and quantum hydrodynamics. An elementary exposition of mathematical techniques used in these theories is included. Linear and nonlinear hydrodynamics, bulk viscosity, rheology, and turbulence are surveyed briefly. (R.J.S.)

3581 (UCRL-6579) IONIZATION FROM SQUARE WELLS. Stephen G. Brush (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 15, 1961. Contract W-7405-eng-48. 19p.

The spherical square-well potential, $V(r) = -V_0$ for $r \leq a$, $V(r) = 0$ for $r < a$, is used as a molecular model, and two ways of removing particles bound in such a well are described. The well is enclosed in a concentric spherical box with infinitely hard walls, so that the energy levels in the well become volume-dependent, and the highest bound state in the well may be squeezed out as the box is compressed. Particles in bound states may be knocked out by bombardment with fast electrons; the ionization cross sections are calculated using the Born approximation, and relative probabilities of finding the resulting molecule-ion in various excited states are given. (auth)

3582 (UCRL-6679) RATES OF HYDROGEN ADSORPTION ON SOLIDIFIED GAS FILMS. Angus L. Hunt, Clyde E. Taylor, and John E. Omohundro (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 3, 1961. Contract W-7405-eng-48. 6p.

The rate of hydrogen adsorption on solidified gas films of Ar, O_2, H_2O, and CO_2 was measured in terms of the pumping speed of a geometrical surface area of 3×10^3 cm^2 or 5×10^3 cm^2. Results are given. (R.J.S.)

3583 OBSERVATION OF THERMOELECTRONS BY MEANS OF GEIGER-MÜLLER COUNTERS. K. W. Ettinger and W. Mościcki (Technical Univ., Danzig). Acta Phys. Polon., 22: 129-32(1962). (In English)

The detection and measurement of thermoelectron currents from W and a Cu–Ni alloy are described. The metal whose thermoemission current is to be measured is used as the cathode in a G-M tube, and Ar and Ar–ethanol mixtures are used as the filler gases. Voltage pulses are applied to the cathodes, which are at 500 to 1100°K, and the currents are measured as functions of the cathode temperature and the pulse duration. (T.F.H.)

3584 WING FORMULAE FOR STARK-BROADENED HYDROGEN AND HYDROGENIC LINES. Hans R. Griem (Univ. of Maryland, College Park and Naval Research Lab., Washington, D. C.). Astrophys. J., 136: 422-30 (Sept. 1962).

Asymptotic expressions are given for the behavior of Stark profiles at large distances from the line center. For the broadening by ions, the quasi-static approximation is used throughout. Depending on the distance from the line center, the electron contribution is calculated with the

usual impact approximation, with a modified impact approximation due to Lewis, or on the far wings of the lines with the quasi-static approximation. The validity regions of the various approximations are delineated, and the errors introduced into previous calculations of complete line profiles by neglecting the Lewis modification are discussed. The requirement that the transitions between the various approximations be smooth leads to a new estimate for the strong collision term in the impact broadening. (auth)

3585 THE SHIFT AND BROADENING OF THE RESONANCE DOUBLET OF Ba II CAUSED BY He AND Ar COLLISIONS. Gordon L. Hammond (Naval Ordnance Lab., White Oak, Md.). Astrophys. J., 136: 431-7(Sept. 1962).

The frequency shifts and half-widths of the S^2-P^2 resonance doublet of Ba II have been observed in emission in the range of pressures from 400 to 1100 atm. and accompanying temperatures of 3300 to 5000°K. These conditions were generated by a rapid gas-compression technique, and the temperatures achieved were sufficient to vaporize Ba salts and to produce Ba ions whose radiation could be spectrographically detected. With He as the perturbing gas, the $P^2_{1/2}$ (λ 4934) component shifted toward the violet, while the $P^2_{3/2}$ (λ 4554) component remained unshifted; both lines exhibited symmetric intensity profiles. With Ar as the perturbing gas, both lines shifted toward the red, and both lines possessed marked red asymmetry. Qualitative agreement was noted between the behavior of these Ba II lines and the corresponding doublets of neutral alkali atoms perturbed by the same gases, but the form of the interaction potential between these excited ions and the rare-gas atoms could not be determined by application of existing theories of line broadening. (auth)

3586 IONIZATION-EQUILIBRIUM EQUATION OF STATE. IV. DENSE PLASMAS AND LIQUID METALS. Carl A. Rouse (Univ. of California, Livermore). Astrophys. J., 136: 665-70(Sept. 1962). (UCRL-5695-T(Pt.5))

A new approach to the theoretical computation of the equation of state of dense plasmas and liquid metals is presented. The method uses the author's complete solution of Saha's equation, modified by a correction to the ionization potentials that is based on Ecker and Weizel's solutions of the Schrödinger equations for an electron in a Debye field. At densities relative to solid densities of 0.1, 1.0, and 10.0, the results over a large temperature range are in agreement with results computed using the Thomas-Fermi (TF) and the Debye-Hückel, Thomas-Fermi (DHTF) models of the atom. Results for iron are compared with published results. At low temperatures, the perfect gas (NkT) pressures calculated by the author's method fall below the TF pressure; this is to be expected because the TF method does not handle partial ionization correctly. At low densities, pressures calculated by using the correction to the ionization potential discussed here agree exactly with pressures calculated by using the correction to the ionization potentials derived by minimizing free energy. The relative abundances of the ions are also the same. Debye-Hückel pressure corrections and the degeneracy of the free electrons are also considered. (auth)

3587 A PERTURBATION CALCULATION FOR A "g − 2" EXPERIMENT. Peter Rastall (Univ. of British Columbia, Vancouver). Can. J. Phys., 40: 1271-4(Sept. 1962).

It has been suggested that a precise measurement of g might be made by taking a beam of electrons in a constant magnetic field B_0, perturbing them with a magnetic field $B = B(x,t)$ of frequency $\eta/\hbar$, and observing the resulting transitions between states whose energies differ by η. These transitions involve a change of spin state. Since the spin-dependent part of the perturbation hamiltonian is $(e\hbar g/4m_0c)\sigma_k B_k$ where the $\sigma_k (k = 1,2,3)$ are the Pauli spin matrices, the transition amplitude between the states $|nlps)$ and $|n'l'p's')$ is, to the first order in perturbation theory, proportional to $(n'l'p's'|\sigma_k B_k|nlps)$. These matrix elements are calculated. (W.D.M.)

3588 EVIDENCE OF A POST-IONIZATION IN AN ION SOURCE OF THE DUOPLASMATRON TYPE. Guy Gautherin (Institut d'Electronique, Orsay, France). Compt. Rend., 255: 653-5(July 1962). (In French)

An ion source of the duoplasmatron type, in which it was possible to vary a large number of the electric, magnetic, and geometric parameters, was constructed to study the physical mechanisms of the operation. The experimental setup was illustrated and described. A disc-shaped insert in the anode was used to vary the topography of the magnetic induction. It was found that the induction curve obtained when copper was used as the disc insert was completely different from that obtained when steel was used. A post-ionization mechanism was proposed to explain the existence of this difference. This hypothesis was confirmed, and the secondary ionization partially explains the high ionization obtained with duoplasmatrons. (J.S.R.)

3589 THERMIONIC GENERATORS. D. A. Fraser and G. G. Isaacs (General Electric Co., Wembley, Eng.). Electron. Eng., 34: 307-11(May 1962).

Power output and efficiency under idealized conditions are calculated for various electrode materials and temperatures. Methods of space charge neutralization are considered, including ionization of cesium at the emitter surface and the use of auxiliary discharges for ion production. Possible applications cover a wide range of power. (auth)

3590 THE WAVE LENGTH DEPENDENCE OF THE ENERGY YIELD OF PHOSPHORS UNDER EXCITATION WITH X RAYS. K. Heilig (Friedrich-Schiller Universität, Jena, Ger.). Exptl. Tech. Physik, 10: 187-95(1962). (In German)

After some remarks on the general pattern of the energy yield as a function of the wave length of the exciting radiation, additional measurements on $CaWO_4$ were reported. Within the framework of the present theory of radiationless transitions and electron excitation processes, no simple explanation of the strong dependence (found by Eggert and Schopper) of the energy yield of the luminescence of $CaWO_4$ on the wave length of the exciting radiation appears to be possible. A brief description of the measurement method, was given. The experimental results showed that the energy yield of the phosphor, within the framework of the measurement accuracy, is independent of the wave length of the exciting x radiation. Measurements of the time pattern of the luminescence of NaI(Tl), KI(Tl), and $CaWO_4$ were carried out. (tr-auth)

3591 AN ELECTRICALLY CONTROLLED MHD VISCOUS COUPLER. E. W. Gaylord, W. F. Hughes, and R. A. Elco (Carnegie Inst. of Tech., Pittsburgh). J. Electron. Control, 13: 45-57(July 1962).

Electrical control of torque-speed characteristics can be made a feature of a viscous coupler, when it consists of a conducting, incompressible, fluid film between two closely spaced, rotating, insulated plates placed in an axial magnetic field. An analysis of the two-dimensional magnetohydrodynamic flow in the film shows that the torque-speed relationship for each plate is a function of the Hartmann number, M (proportional to the magnetic field), and the current density in the film. If a voltage is applied between concentric electrodes located in the film, the torque-speed

relationships are functions of the applied voltage and the applied magnetic field. For large Hartmann numbers (M greater than 1), the output plate torque is linearly related to M. The overall efficiency of this coupler is, at its best, slightly greater than that of the ordinary viscous coupler. (auth)

3592 A STUDY OF SOME PROPERTIES OF AN ELECTROSTATIC QUADRUPOLE LENS USING AN AUTOMATIC ELECTRON TRAJECTORY TRACER. B. C. Gregory and K. F. Sander (Cambridge Univ., Eng.). J. Electron. Control, 13: 123-36(Aug. 1962).

A particular form of electrostatic quadrupole lens is investigated with the aid of an electron trajectory tracer. The lens consists of two coaxial cylinders, the outer being at cathode potential and the inner at anode potential. Two symmetrically placed longitudinal slots in the inner produce a quadrupole-type field near the axis. Focal length, focal point, and spherical aberration coefficient are given as functions of slot length for the two planes of symmetry. (auth)

3593 A STUDY OF THE COMBINED EFFECT OF THERMAL RADIATIVE TRANSFER AND A MAGNETIC FIELD ON THE GRAVITATIONAL CONVECTION OF AN IONIZED FLUID. M. P. Murgai and P. K. Khosla (Defence Science Lab., Delhi). J. Fluid Mech., 14: 433-51(Nov. 1962).

The effect of radiative transfer on the thermal stability of an ionized fluid, in the presence of uniform vertical magnetic field is examined from hydromagnetic approximations. Two asymptotic cases, viz. when the fluid is optically thin and when it is optically thick, are examined in detail. The principle of exchange of stabilities and the concept of overstability are discussed, and the physical conditions under which the former is valid are obtained. Also, the conditions as to which type of instability arises first are derived. It is shown that in the presence of large magnetic field overstability arises earlier than convection in a first approximation. (auth)

3594 ANALYSIS OF EXPLORER 11 ORIENTATION. R. J. Naumann, S. A. Fields, and R. L. Holland (George C. Marshall Space Flight Center, Huntsville, Ala.). J. Geophys. Research, 67: 3619-23(Aug. 1962).

In support of the Explorer 11 gamma ray astronomy experiment, a group at Marshall Space Flight Center developed a simple but highly accurate method of determining the spatial orientation of the angular momentum vector of the satellite. The determination is accomplished by successive measurements of the angle the ray path from the satellite to the receiving station makes with the axis of rotation of the satellite. (W.D.M.)

3595 THE CROSS SECTION FOR SCATTERING OF ELECTROMAGNETIC WAVES FROM AN IONIZED GAS IN THERMAL NONEQUILIBRIUM. Jacques Renau (Cornell Univ., Buffalo). J. Geophys. Research, 67: 3624-26(Aug. 1962).

The results of ionospheric experiments, conducted in Peru, are considered in the light of theoretical predictions for the scattering cross section per unit volume when $T_e \neq T_i$. It is assumed that the ions of the gas consist of one kind of positive ions at temperature T_i and mean density $\overline{N}_i^+$ as well as one kind of negative ions of temperature T_i and mean density $\overline{N}_i^-$. (W.D.M.)

3596 A NOTE ON THE GENERATION OF THE MAIN-PHASE RING CURRENT OF A GEOMAGNETIC STORM. J. W. Kern (Rand Corp., Santa Monica, Calif.). J. Geophys. Research, 67: 3737-51(Sept. 1962).

A model is described which permits an approximate calculation of the effects of repeated hydromagnetic shock waves on particles trapped in the magnetosphere. It is shown that an existing trapped plasma might be accelerated to yield an energetic particle distribution with the characteristics of a ring current. The change in magnetic moment ΔM of such a ring current is calculated approximately as a function of the number n of hydromagnetic shock events. The approximate change in magnetic field ΔH at the earth is also calculated as a function of n. Observed time variations of ΔM and ΔH are compared with the behavior of the model. The implications of the mechanism relative to other geomagnetic disturbances and to auroras are also discussed. (auth)

3597 ON GEOMAGNETIC SUDDEN COMMENCEMENTS, SUDDEN IMPULSES, AND STORM DURATIONS. S. Matsushita (High Altitude Observatory, Boulder, Colo.). J. Geophys. Research, 67: 3753-77(Sept. 1952).

After a study of the morphology of geomagnetic sudden commencements during the IGY, their accompanying phenomena, such as sudden increases of cosmic noise absorption, bursts of bremsstrahlung x rays, and commencements of geomagnetic micropulsations, are examined. Geomagnetic sudden impulses observed during the IGY are then studied similarly. Four types are found, three of which are completely analogous, both in their morphologies and in their accompanying phenomena, to the corresponding types of sudden commencements. The average duration of the storm depression of the horizontal geomagnetic field, usually attributed to the ring current, is also studied. Storms during years of great solar activity are found to be about three times longer than those during years of little solar activity. The spectrum of storm durations is found; it is concluded that even sudden impulses belong to the family of storms. Possible causes of all these related phenomena, including increases of cosmic noise absorption and micropulsations, are discussed. (auth)

3598 FLOW OF PLASMA AROUND THE EARTH. P. J. Kellogg (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 67: 3805-11(Sept. 1962).

The interplanetary plasma flow measured by means of Explorer 10 is supersonic in the sense that the flow speed is greater than the Alfvén speed. It is shown that this has some of the same implications as supersonic flow does in ordinary fluid flow theory, and possible consequences are discussed. The position of the shock that would develop if the interplanetary plasma were a perfect gas with a short mean free path is calculated and is shown to be well outside the orbit of Explorer 10, so that it would not have been seen. Speculations on the possible structure of the shock in collisionless plasma are given, and it is shown that this structure may account for the turbulent character of the distant magnetic field. (auth)

3599 GLOBAL ATMOSPHERIC PRESSURE EFFECTS OF THE OCTOBER 30, 1961, EXPLOSION. H. Wexler and W. A. Hass (U. S. Weather Bureau, Washington, D. C.). J. Geophys. Research, 67: 3875-87(Sept. 1962).

The atmospheric pressure waves set off by the explosion of October 30, 1961, were traced over a large portion of the world, including the antipodes in the Antarctic, by means of analyses of available ordinary microbarograph records. The observed geographic variations in propagation speed and maximum amplitude are examined with the aid of air density and wind analyses. Comparison is made with the waves resulting from the great Siberian meteor of 1908 and the Krakatoa eruption of 1883. (auth)

3600 PROPAGATION OF ACOUSTIC-GRAVITY WAVES IN THE ATMOSPHERE. Frank Press and David

Harkrider (California Inst. of Tech., Pasadena). J. Geophys. Research, 67: 3889-3908(Sept. 1962).

Homogeneous wave guide theory is used to derive dispersion curves, vertical pressure distributions, and synthetic barograms for atmospheric waves. A complicated mode structure is found involving both gravity and acoustic waves. Various models of the atmosphere are studied to explore seasonal and geographic effects on pulse propagation. The influence of different zones in the atmosphere on the character of the barograms is studied. It is found that the first arriving waves are controlled by the properties of the lower atmospheric channel. Comparison of theoretical results and experimental data from large thermonuclear explosions is made in the time and frequency domains, and the following conclusions are reached: (1) The major features on barograms are due to dispersion; (2) superposition of several modes is needed to explain observed features; (3) scatter of data outside the range permitted by extreme atmospheric models shows the influence of winds for A_1; wind effects and higher modes are less important for A_2 waves. A discussion is included on atmospheric terminations and how these affect dispersion curves. (auth)

3601 ZENITH AIRGLOW OBSERVATIONS DURING THE HIGH-ALTITUDE NUCLEAR EXPLOSION OF JULY 9, 1962. F. Kirk Odencrantz, Pierre Saint-Amand, and James G. Moore (Naval Ordnance Test Station, China Lake, Calif.). J. Geophys. Research, 67: 4091-2(Sept. 1962).

The effects of the July 9, 1962, explosion on the zenith airglow at China Lake, California, were observed by means of photometers containing interference filters centered at the wavelengths 5270, 6300, 5577, and 3914Å. The observations suggest that an intense pulse of electromagnetic radiation, x rays and/or a beam of neutrons, reached the atmosphere above China Lake. (W.D.M.)

3602 NOTE ON PARA-ORTHO CONVERSION IN SOLID DEUTERIUM. Kazuko Motizuki (Univ. of Osaka). J. Phys. Soc. Japan, 17: 1192(July 1962). (In English)

In a previous study of para-ortho conversion in solid D_2 the Debye temperature as a function of temperature was determined to be 105°K at 4°K from lattice specific heat measurements. The rate of the one phonon emission process is reported. (W.D.M.)

3603 A PULSED MAGNET FOR HIGH MAGNETIC FIELDS. R. Evangelisti, G. Pasotti, and G. Sacerdoti (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). Nuclear Instr. & Methods, 16: 189-94(July 1962). (In English)

The design of a pulsed coil to obtain 200 kg in a large volume and some experimental results of the preliminary tests on it are described. The electrical dissipation in the copper is much smaller than that calculated assuming the current concentrated in a sheet of thickness is determined by the skin effect and of radius equal to the inner radius of the coil. The preliminary tests give some information how to correct the design. (auth)

3604 ELECTRON CYCLOTRON RESONANCES IN A RADIOFREQUENCY ION SOURCE. Iwao Ogawa (Rikkyo Univ., Tokyo) and Nagao Abe. Nuclear Instr. & Methods, 16: 227-32(July 1962). (In English)

An axial magnetic field was applied to a Thonemann type radiofrequency ion source and the resonance-like increase in the probe current at a certain field was observed for various operating frequencies. The resonance was found to occur at a field-strength about four times larger than the field for which the cyclotron frequency of electrons is just equal to the operating frequency, independent of the kind of gases used. It is suggested that the resonance may correspond to one of the parametric resonances of plasma electrons which are expected to occur in an r-f-modulated magnetic field. The favored excitation of the fourth harmonic is tentatively attributed to the suppression of other (higher or lower) harmonics by the collision of accelerated electrons with either a gas molecule or the wall of the discharge tube. (auth)

3605 MOBILITY AND THERMOELECTRIC POWER IN MANY-VALLEY POLAR SEMICONDUCTORS. Doris J. Olechna and H. Ehrenreich (General Electric Research Lab., Schenectady, N. Y.). Phys. Chem. Solids, 23: 1513-20(Nov. 1962). (In English)

The mobility, μ, and the thermoelectric power, Q, were calculated variationally for polar semiconductors having ellipsoidal energy surfaces in which the polar electron phonon interaction is dominant. Equations applicable to both Fermi and Boltzmann statistics are presented. Numerical results for μ and Q for the latter case are given as a function of temperature for varying degrees of ellipticity. These show that the thermoelectric power is relatively insensitive to changes in ellipticity. A simple approximate formula for the mobility given previously is shown to agree well with the results of the variational method. (auth)

3606 STUDIES OF ELECTRICAL CONDUCTIVITY OF Nb_2O_5 AS A FUNOTION OF OXYGEN PRESSURE AT 600–1200°C. P. Kofstad (Central Inst. for Industrial Research, Blindern, Oslo). Phys. Chem. Solids, 23: 1571-8 (Nov. 1962). (In English)

The electrical conductivity of α-Nb_2O_5 at 750–1200°C was found to be proportional to $p_{O_2}^{-1/4}$ in the oxygen pressure range 1–0.001 atm. Corresponding studies in mixtures of CO and CO_2 suggested that the electrical conductivity was proportional to $p_{O_2}^{-1/6}$ at oxygen vacancy concentrations larger than approximately $10^{19}/cm^3$. The change in oxygen pressure dependence was interpreted in terms of decreasing ionization energies of trapped electrons with increasing defect concentrations. At temperatures below 700°C anomalies in the oxygen pressure dependence of the electrical conductivity of both α- and γ-Nb_2O_5 were observed. (auth)

3607 USE OF VIRTUAL BOUND STATES IN THE RARE EARTH METALS. Y. A. Rocher (Faculté des Sciences, Service de Physique des Solids, Orsay, France). Phys. Chem. Solids, 23: 1621-9(Nov. 1962). (In French)

A bound state model for the f electron in cerium which gives a rather unsatisfactory picture of the properties of the metal, is well understood if a virtual bound state model is used. The correlations between electrons lead to f virtual states of well defined mean energies and about 10^{-2} ev broad. In cerium, the f_1 and f_2 levels should overlap at the Fermi level, with about 0.8 electron in the f_1 level and 0.2 in the f_2 level. In the same way, it is possible to explain the very high resistivity observed in ytterbium under high pressures. (auth)

3608 PROTON CONDUCTIVITY IN BORAX, $Na_2[B_4O_5(OH)_4] \cdot 8H_2O$. S. Maricic, V. Pravdic, and Z. Veksli (Institut "Rudjer Boskovic," Zagreb). Phys. Chem. Solids, 23: 1651-9(Nov. 1962). (In English)

Proton conductivity was established by solid state electrolysis experiments on borax powder. There was marked anisotropy in electrical conductivity, the b-axis-direction of a single crystal being the most favorable one for protonic conduction. A minimum temperature (~21°C) was observed, below which proton conduction ceased. The effect is discussed in relation to the competition between the reorientation rate of protons and their concentrations. (auth)

3609 BORN REPULSIVE ENERGY IN SODIUM CHLORIDE AND POTASSIUM CHLORIDE CRYSTALS. F. G. Fumi and M. P. Tosi (Argonne National Lab., Ill.). Phys. Chem. Solids, 23: 1671-7(Nov. 1962). (TID-15797) (In English)

It is shown that, contrary to recent statements in the literature, the accuracy with which the Born repulsive energy in an alkali halide crystal can be determined from available thermodynamic crystal data at atmospheric pressure is limited to the accuracy of the experimental electron affinity of the pertinent halogen atom. This is due to the ambiguity of the functional form of the Born repulsive energy. Other evidence is necessary, and partly available, to remove the ambiguity. When a specific form for the Born repulsive energy is assumed, a procedure proposed recently for the determination of this energy from data at atmospheric pressure is shown to be equivalent to the traditional procedure, at least for the alkali halides whose Debye characteristic temperature is below room temperature. Detailed analyses were carried out for sodium and potassium chloride crystals. (auth)

3610 ELECTRICAL CONDUCTIVITY AND THERMOELECTRIC POWER OF INDIUM OXIDE. M. J. Arvin (Southern Illinois Univ., Carbondale, Ill.). Phys. Chem. Solids, 23: 1681-3(Nov. 1962). (In English)

Electrical conductivity and thermoelectric power of pressed samples of polycrystalline indium oxide (In_2O_3) powder were measured in air as a function of temperature from 180 to 460°C. The conductivity curve consisted of two segments with a change of slope at 290°C and closely resembled calcium oxide with a break at 500°C. The thermoelectric power was negative in all cases indicating n-type conduction. (P.C.H.)

3611 ELECTROHYDRODYNAMIC AND MAGNETOHYDRODYNAMIC NONLINEAR SURFACE WAVES. James R. Melcher (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 5: 1037-43(Sept. 1962).

A nonlinear formulation of electrohydrodynamic and magnetohydrodynamic surface interactions is developed which, in the absence of magnetic or electric fields, becomes the classical "long" gravity-wave theory. The results are valid for a shallow highly conducting fluid that interacts strongly with a rigid highly conducting plate in such a way as to either conserve an electric potential difference or a magnetic flux. The growth of surface discontinuities from compression and depression waves is discussed, with transition electrohydrodynamic waves originating from timelike data given to illustrate waves that are partly controlled by gravity and partly by the electric field. Waves initiated from spacelike data are also described, and the integral jump conditions derived. (auth)

3612 ANALOGY BETWEEN THE RAYLEIGH PROBLEM AND FLOW BEHIND THE SHOCK WAVE IN MAGNETOHYDRODYNAMICS. Jan Rosciszewski (Harvard Univ., Cambridge, Mass.). Phys. Fluids, 5: 1044-7(Sept. 1962).

The flow behind a shock wave that propagates through a perpendicular magnetic field along a flat plate of high conductivity is analyzed under the assumption of small magnetic Prandtl number. Under such circumstances the regime of influence of magnetic diffusion is much thicker than the viscous boundary layer and the flow can be treated as essentially inviscid. On this basis it is shown that the problem becomes analogous to the Rayleigh problem, insofar as the velocity distribution along the wall is concerned, provided that the velocity of flow behind the shock wave is exactly equal to the Alfvén velocity. (auth)

3613 PRODUCTION OF A BARIUM PLASMA. A. Z. Kranz (Princeton Univ., N. J.). Phys. Fluids, 5: 1128(Sept. 1962).

An atomic beam of barium was produced by heating the metal to ~900°C in a molybdenum oven and allowing the vapor to flow through a collimator of stacked 0.010-in. ID molybdenum tubes. The barium atoms were ionized by contact with a 2500°K rhenium plate. A density of $10^{12}/cm^3$ was achieved. A sodium plasma was also produced by bombardment on rhenium. (W.D.M.)

3614 GAS-FLOW VISUALIZATION USING LOW-DENSITY PLASMA STREAMS. Allan I. Carswell (RCA Victor Co., Montreal). Phys. Fluids, 5: 1128-30(Sept. 1962).

Some recent developments in the techniques of visualizing a luminescent gas flow are presented which were employed during a series of experiments on the study of the properties of low density plasmas flowing at supersonic velocities. The flow system provides gas velocities up to Mach 2 at pressures of 0.1 to 10 mm Hg. The diameter of the supersonic stream is of the order of 2 cm and the gas used is argon. The gas is excited by an electrodeless discharge operating at a frequency of 13.5 Mc. (W.D.M.)

3615 ELECTRIC-FIELD HEATING THRESHOLD FOR CHARGED PARTICLES. Anthony Demetriades (California Inst. of Tech., Pasadena). Phys. Fluids, 5: 1134-6(Sept. 1962).

In deriving expressions for the electrical conductivity in a gas the importance of the elevated electron temperature to the conduction process has been recognized. It is pointed out that the role of the local electric field in maintaining the temperature difference (nonequilibrium) between the electrons and the other species, and a threshold in the field strength below which the electronic (and ionic) mobilities are independent of field strength, can be derived from elementary considerations. (W.D.M.)

3616 SPECIFIC HEAT OF LIQUID He^3. Myron Strongin, George O. Zimmerman, and Henry A. Fairbank (Yale Univ., New Haven). Phys. Rev., 128: 1983-8(Dec. 1, 1962).

The specific heat of liquid He^3 was measured at saturated vapor pressure and at three elevated pressures in the temperature range 0.054 to 0.3°K. No evidence of a transition to a correlated superfluid phase was found. At the lowest temperatures the specific heat was nearly proportional to T in agreement with other recent measurements. Entropy values are calculated at each pressure. Measurements at pressures above the minimum in the melting curve show no anomalous behavior. Measurement of the expansion coefficient of the liquid below 0.1°K confirms that the expansion coefficient is negative. (auth)

3617 BACK DIFFUSION OF ELECTRONS IN NITROGEN, HYDROGEN, AND ARGON. John A. Dahlquist (Washington Univ., St. Louis). Phys. Rev., 128: 1988-92 (Dec. 1, 1962).

The back diffusion of electrons to an emitting surface results in the decrease of i_θ, the current leaving the cathode, to i, the current arriving at the anode in the presence of a gas. The ratio of i/i_θ is a function of the random thermal velocity and the drift velocity, and these velocities in turn are functions of E/p, the electric field strength-to-pressure ratio. An experiment was performed which controlled these velocities independently over wide ranges in the gases nitrogen, hydrogen, and argon. In accordance with theoretical prediction, the value of i/i_θ was found to

decrease with increasing thermal velocity and to increase with increasing drift velocity. Typical measured values of i/i_0 for both thermal velocity and drift velocity appropriate to E/p of 2 V/cm per mm Hg were 0.06 in N_2, 0.075 in H_2, and 0.05 in Ar, indicating the low probability of escaping back diffusion at this value of E/p. (auth)

3618 OSMOTIC PRESSURE OF He^3 IN LIQUID He^4, WITH PROPOSALS FOR A REFRIGERATOR TO WORK BELOW 1°K. H. London (Atomic Energy Research Establishment, Harwell, Berks, Eng.), G. R. Clarke, and Eric Mendoza. Phys. Rev., 128: 1992-2005(Dec. 1, 1962).

An experimental study has been carried out of the osmotic pressure of solutions of the isotope He^3 in liquid He^4 at low temperatures, between 0.8 and 1.2°K. A superleak, a tube packed with a fine powder, acted as a semipermeable membrane which allowed only the superfluid He^4 to pass. The conclusion from these experiments was that the measured osmotic pressures were in reasonable agreement with values expected from the thermodynamic relations with other equilibrium properties of the mixtures, notably their vapor pressures. Thermodynamic equilibrium therefore seemed to have been attained under the conditions of the experiments. The second half of this paper concerns a study of the cooling which must take place during the adiabatic dilution of He^3 by He^4. If the dilution is carried out at low temperatures where the solutions separate into two phases, the absorption of heat is estimated to be usefully large. After dilution the solution can be distilled, condensed and recirculated so as to make a continuously acting refrigerator. It should be possible to operate at temperatures of 0.1°K or below. (auth)

3619 STABILITY OF FORCE-FREE MAGNETIC FIELDS. D. Voslamber and D. K. Callebaut (Institut d'Astrophysique, Paris). Phys. Rev., 128: 2016-21(Dec. 1, 1962).

A formalism for treating the stability of force-free magnetic fields ($\nabla \times B = \alpha B$) based on the energy principle of Bernstein et al. is derived. An example is given to show that force-free fields with constant α may be unstable, though previous papers give arguments in favor of the stability of such fields. It is found that the cylindrically symmetric force-free field given by Lundquist is unstable if and only if αr_0 (where r_0 is the radius of the cylinder) exceeds the critical value 3.176. The unstable displacements have small growth rates. They are of the screw or kink type, their wavelengths along the axis having a minimum of about seven times the critical cylinder radius. The results are applied to the arms of spiral galaxies, correcting Trehan's statement that some force-free fields with constant α have a stabilizing effect on gravitational instability. (auth)

3620 ANTIFERROMAGNETISM OF THE ANTIPHASE DOMAIN STRUCTURE OF Pd_3Mn. J. W. Cable, E. O. Wollan, W. C. Koehler, and H. R. Child (Oak Ridge National Lab., Tenn.). Phys. Rev., 128: 2118-20(Dec. 1, 1962).

Neutron diffraction measurements were made on polycrystalline samples of a 75% Pd–25% Mn alloy. It was found that long-range positional order could be obtained by appropriate heat treatment and that this order was of the one-dimensional antiphase domain type with a period of 4 cubic unit cells. Below 170°K antiferromagnetic reflections were observed for this ordered alloy. A magnetic structure is proposed which satisfactorily accounts for the observed magnetic reflection intensities. On the basis of this structure the atomic magnetic moments are $(4.0 \pm 0.2)_{\mu B}$/Mn and $(0.2 \pm 0.1)_{\mu B}$/Pd. (auth)

3621 SHIELDING AND CRYSTAL FIELDS AT RARE-EARTH IONS. Gerald Burns (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 128: 2121-30(Dec. 1, 1962).

Several aspects of the crystal field problem of rare-earth ions in ionic solids are discussed. In particular, three problems are considered. (1) A calculation is performed to determine to what extent the $5s^2p^6$ electrons shield the 4f electrons from the crystal field. The shielding is small (<10%) and unimportant compared to the many other uncertainties in crystal field calculations. The calculation was carried out by considering the crystal field, $\Sigma B_n^m r^n Y_n^m$, as a perturbation on the $5s^2$ and $5p^6$ state. The excited state wave functions are calculated and the extra potential, $\Sigma B_n^m Y_n^m F_{n,m}(r)$, due to the distorted charge distribution is compared to crystal potential. (2) The reason as to why the rare-earth ions effectively see smaller crystal fields than the iron series ions is considered by performing the lattice sums in several typical lattices so that the B_n^m coefficients could be compared. One observes that the crystal field to spin-orbit coupling ratio is considerably larger in the iron series ions than for the rare-earth ions for straightforward reasons (the ion series ions have $B_n^m \approx 3$ to 10 times larger, $r_n \approx 2$ times larger and spin-orbit coupling constants $\approx 1/2$ as large as the rare-earth ions). Thus, the difference in behavior between these two groups of ions comes about for straightforward reasons without resorting to shielding. (3) The calculated crystal field parameters, $(r_n)B_n^m = V_n^m$, for the rare-earth ions are compared with those obtained by fitting optical levels. A discussion of the problems involved in calculating the lattice sums (B_n^m) is given and one can see why detailed agreement is not expected. The calculated V_n^m for n = 4 and 6 are reasonable but smaller than those obtained from the optical data. Little can be said for the n = 2 terms because of the uncertainties involved in the lattice sums. (auth)

3622 NUCLEAR MAGNETIC SPECIFIC HEAT OF FERROMAGNETIC IRON ALLOYS WITH Sb AND Re. O. V. Lounasmaa (Argonne National Lab., Ill.), C. H. Cheng, and Paul A. Beck. Phys. Rev., 128: 2153-4(Dec. 1, 1962).

The effective field at the nuclei of Sb and Re solute atoms in Fe was determined by low-temperature specific heat measurements. For Sb, $H_{eff} = 170 \pm 8$ kOe; for Re, $H_{eff} = 610 \pm 35$ kOe. (auth)

3623 RELATION BETWEEN ABSORPTION AND EMISSION PROBABILITIES IN LUMINESCENT CENTERS IN IONIC SOLIDS. W. Beall Fowler and D. L. Dexter (Univ. of Rochester, N. Y.). Phys. Rev., 128: 2154-65 (Dec. 1, 1962).

It is pointed out that the Einstein relationship between spontaneous emission probability and induced absorption probability for radiative transitions is not generally valid for impurity centers in condensed media. An alternative approach to the problem is available by which estimates of the possible discrepancies can be made. Several mechanisms are discussed, particularly the Jahn-Teller effect, which depend on the existence of the phonon field and the lattice relaxation following absorption of a photon. In some simple cases, such as the F center in KCl and LiF, the decay time predicted from the integrated absorption cross section may differ by an order of magnitude from that observed. In other simple and cubic systems, where the atomic symmetries are appropriate, the discrepancy may be even larger. In noncubic crystals similar discrepancies may be expected. (auth)

3624 BAND STRUCTURE AND POSITRON ANNIHILATION IN METALS: Be AND Mg. Stephan Berko (Brandeis Univ., Waltham, Mass.). Phys. Rev., 128: 2166-8(Dec. 1, 1962).

The angular correlation of positron annihilation radiation

from oriented beryllium and magnesium crystals has been measured. The derivatives of the angular distributions from beryllium show fine structure and marked anisotropy compared to the observed nearly isotropic behavior of magnesium. A qualitative theoretical interpretation of the data is given in terms of the Bloch functions of the conduction band. It is emphasized that the correlation curves are sensitive to the details of these wave functions and do not yield directly cross-sectional areas of the Fermi distribution. (auth)

3625 PRODUCTION OF LYMAN ALPHA RADIATION IN ION-ATOM COLLISIONS. Gordon H. Dunn, Ronald Geballe, and Donavon Pretzer (Univ. of Washington, Seattle). Phys. Rev., 128: 2200-6(Dec. 1, 1962).

The absolute cross section as a function of incident ion energy has been measured for the production of Lyman alpha radiation (using an O_2-filtered, iodine-filled Geiger counter as a detector) when ions impact on gases. The principal reactant pairs studied were: (He^+,H_2), (H_2^+,He), (H^+,He), (H^+,H_2), and (H_2^+,H_2) in the energy range from about 100 to 6500 ev. Reaction mechanisms are discussed for each case. The data are found in most cases to agree qualitatively with the adiabatic hypothesis of Massey. Cross sections also were measured for the production of countable ultraviolet radiation with the following reactant pairs: (H_2^+,H_2), (H_2^+,He), (H^+,N_2), (H_2^+,N_2), (H_2^+,N_2), and (He^+,N_2). No mechanisms are proposed for these cases. In an auxiliary experiment, the probability for producing ultraviolet radiation when H^+ and H_2^+ impinge on a metal surface was measured to be about 0.005 photon/ion. (auth)

3626 MÖSSBAUER EFFECT IN METALLIC IRON. R. S. Preston, S. S. Hanna, and J. Heberle (Argonne National Lab., Ill.). Phys. Rev., 128: 2207-18(Dec. 1, 1962). (TID-16872)

The Mössbauer effect in metallic iron has been studied from 4 to 1300°K, with particular emphasis on the region near the Curie temperature at 1043°K. Measurements of the internal field H_n at the nucleus agree with nuclear magnetic resonance measurements and follow closely, but not exactly, the saturation magnetization curve of iron. No internal field is observed above the Curie temperature. At room temperature $H_n = 330 \pm 3$ kOe. The ratio of magnetic moments of the two lowest levels of Fe^{57} is $\mu_1/\mu_0 = -1.715 \pm 0.004$. The observed temperature shift in the energy of the resonant radiation may be attributed chiefly to relativistic time dilation. In the low-temperature region the variation is nonlinear and compatible with a Debye temperature $\theta = 400 \pm 30$°K, although the data indicate that θ is not strictly independent of temperature. At high temperatures, the classical limit $(1/E)\partial E/\partial T = -3k/2Mc^2$ for the relativistic shift is attained and perhaps exceeded. Disagreement with the classical limit would indicate a temperature variation in the isomer shift. At the Curie point and at the transition from α to γ iron, the discontinuities observed in the temperature shift are too great to be attributed to the relativistic shift. If attributed to the isomer shift, these discontinuities indicate that the electron density at the nucleus increases at the transitions from the ferromagnetic to the paramagnetic state and from α to γ iron. The strength of the resonant absorption was also determined as a function of temperature. These measurements are compatible with a Debye temperature that falls from about 400 to 300°K in passing from low to high temperatures over the range studied. (auth)

3627 COMPARISON OF THE RUBIDIUM-87 AND PROTON ZEEMAN TRANSITION FREQUENCIES IN THE EARTH'S MAGNETIC FIELD. P. L. Bender (National Bureau of Standards, Washington, D. C.). Phys. Rev., 128: 2218-21(Dec. 1, 1962).

Alternate measurements of the earth's magnetic field have been made at the same location with a d-c rubidium-87 magnetometer and with a proton free-precession magnetometer. The accuracy of the measurements is believed to be 1 μG in terms of the rubidium-87 frequency and 3 μG in terms of the proton frequency. The ratio of the g factors for rubidium electrons and for protons in a spherical water sample is found to be 658.234 ± 0.004. The rubidium electron g factor is thus 27 ± 6 parts per million higher than the g factor for electrons in the hydrogen ground state. (auth)

3628 MAGNETIC FIELD DEPENDENCE OF POLARIZED HELIUM LIGHT EXCITED BY ELECTRONS. Robert H. McFarland and Edward A. Soltysik (Univ. of California, Livermore). Phys. Rev., 128: 2222-4(Dec. 1, 1962). (UCRL-6949)

The polarization of light resulting from the excitation of helium atoms by an electron beam has been measured as a function of magnetic field parallel to the electron beam. Results are presented which show that the polarization of the radiation arising from the diffuse singlet transitions in helium is magnetic-field dependent. The polarization of the radiation of the diffuse triplets is not field dependent. Since the magnetic field (parallel to the direction of the electron beam) cannot lead to a reorientation of the atom in its excited state, the polarization of the emitted radiation should not be altered by the magnetic field subsequent to the excitation impact. It would appear, then, that the inelastic scattering of electrons by helium atoms is independent of magnetic field for triplet-state excitation, but dependent for singlet-state excitation. Since theory, as presently developed, predicts that the population probabilities to diffuse singlet and triplet states should depend only on the orbital angular momentum magnetic quantum numbers, one must conclude that the inelastic scattering that is involved is probably more complicated than is usually assumed. (auth)

3629 TWO-PHOTON PHOTOELECTRIC EFFECT. Richard L. Smith (United Aircraft Research Labs., East Hartford, Conn.). Phys. Rev., 128: 2225-9(Dec. 1, 1962).

The surface photoelectric current from a pure metal surface is calculated when the frequency of the incident radiation is less than the threshold frequency but greater than one-half the threshold frequency. To do this, second-order stationary perturbation theory is used. The current thus found is normally small. However at great intensities, such as those produced by optical masers, the current might be measurable. (auth)

3630 CHARGE TRANSFER BETWEEN POSITIVE CESIUM IONS AND CESIUM ATOMS. Lawrence L. Marino, A. C. H. Smith, and E. Caplinger (General Dynamics/Astronautics, San Diego, Calif.). Phys. Rev., 128: 2243-50 (Dec. 1, 1962).

The cross section for charge transfer between cesium ions and cesium atoms has been determined as a function of primary ion energy from 50 to 4000 ev. At each energy the cross section was obtained from measurements of the number of slow ions formed along a known length of the fast primary ion beam in passing through cesium vapor, the primary beam current, and the number density of cesium atoms inside the interaction region. The measured cross sections are higher than those of other investigations within the same energy range in which different methods were used, but are consistent with those of an investigation in the energy range 5 to 25 kev. The result of a least-mean-squares fit indicates that the cross section may be repre-

sented between 50 ev and 4000 ev by the expression $Q^{1/2} \times 10^8 = 26.8 - 1.46\ \ln V$, where Q is the cross section (cm^2) and V is the primary ion beam energy (ev). (auth)

3631 STATISTICAL THEORY OF SPIN RESONANCE SATURATION. Alfred G. Redfield (Columbia Univ., New York). Phys. Rev., 128: 2251-3(Dec. 1, 1962).

In the high-temperature limit for a macroscopic spin system the equivalence of canonical and microcanonical averages is shown to imply that a diagonal element of any extensive operator is simply related to the corresponding energy eigenvalue. This relation permits a steady-state solution of the density matrix transport equation appropriate to spin resonance saturation in the limit of weak spin-lattice relaxation, strong saturation, and homogeneous broadening. The solution corresponds to a thermal distribution with respect to the transformed Hamiltonian in the rotating coordinate system, as had been conjectured previously. (auth)

3632 THEORY OF ELECTRONIC AND IONIC MOBILITY IN LIQUID He^4I AND LIQUID He^3. H. T. Davis, Stuart A. Rice, and Lothar Meyer (Univ. of Chicago). Phys. Rev. Letters, 9: 81-3(Aug. 1, 1962).

A theory is presented of the mobility of electrons (assumed to be the negative charge carriers) and of He_2^+ ions (assumed to be the positive charge carriers) in liquid He^4I and He^3. The theory is found to agree with observed properties of charge carriers in these liquids. The theory contains no adjustable parameters such as cross sections or effective masses. (T.F.H.)

3633 VELOCITY OF SOUND IN LIQUID HELIUM AT LOW TEMPERATURES. W. M. Whitney (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 9: 243-5 (Sept. 15, 1962).

The velocity of ordinary sound in liquid helium was measured at a frequency of 1 Mc/sec between 0.1°K and 1.7°K. The observed change in velocity between the lowest temperatures and 1.6°K is 3.66 ± 0.1 m/sec, and the value for the velocity extrapolated to absolute zero is 238.27 ± 0.1 m/sec. The most significant result is the discovery of a definite maximum in the velocity at 0.66°K. The calculated and experimental curves of the sound velocity have roughly the same characteristics, but theory does not account for the results quantitatively. Some of the possible reasons for this discrepancy are briefly discussed. (H.D.R.)

3634 SUPERCONDUCTING TRANSITION TEMPERATURE OF PURIFIED TECHNETIUM. M. L. Picklesimer (Oak Ridge National Lab., Tenn.) and S. T. Sekula. Phys. Rev. Letters, 9: 254(Sept. 15, 1962).

Microstructural and x-ray diffraction examinations of technetium powder revealed the presence of appreciable quantities of oxygen. Pressed powder pellets were induction melted under a vacuum several times and cold rolled to a sheet with a purity greater than 99.995% for metallic elements. The superconducting transition temperature for a specimen of the sheet in zero magnetic field was found to be 8.22 ± 0.01°K. The previously reported values are 11.2°K for powder of greater than 99.9% purity and 9.3°K for arc-melted material from metal chips contaminated with oxide. Thus, it is postulated that dissolved oxygen raises the transition temperature, and that the superconducting transition temperature for pure technetium is not greater than 8.22°K. (H.D.R.)

3635 UPPER LIMIT FOR THE CRITICAL FIELD IN HARD SUPERCONDUCTORS. A. M. Clogston (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters, 9: 266-7(Sept. 15, 1962).

An examination is presented of some recent reports dealing with the extremely high critical fields in certain hard superconductors. Observations of nuclear magnetic resonance in V_3Si and V_3Ga are shown to set a severe upper limit on the attainable critical field because of a reduction in the spin susceptibility of these materials in the superconducting state. Equations are derived for the maximum critical field using this limiting criterion. A table of maximum and estimated critical fields is presented for $V_{2.86}$ Ga, Nb_3Sn, V_3Si, and $V_{1.95}$ Ga. It is concluded that the critical fields for these β-wolfran compounds are so high that they may be effectively limited at low temperatures by the normal-state paramagnetism. If this is the case, critical fields higher than about 300 kilogauss will not be realized unless materials can be discovered with high transition temperatures. (H.D.R.)

3636 AN ALTERNATIVE DEDUCTION FROM THE MICHELSON-MORLEY EXPERIMENT. C. N. Gordon (English Electric Aviation Ltd., Luton, Eng.). Proc. Phys. Soc. (London), 80: 569-92(Sept. 1, 1962).

A theory is developed from two postulates: that the speed of light is invariant, and that any two synchronized clocks which are separated will again agree on reuniting. The existence of a preferred inertial frame is demonstrated and the coordinate transformations for non-uniform motion are obtained and used in an analysis of a return journey to elucidate further the clock paradox. With electrodynamics and mechanics as examples it is shown that physical laws are invariant in the special case of uniform motion and consequently that many of the arguments alleged to demonstrate special relativity do not in fact do so. However, in the case of non-uniform motion the theory appears to have an inherent restriction to events on the common path of observers with rectilinear motion, and until this restriction can be removed the physical validity of the theory is doubtful. (auth)

3637 NEW BAND SYSTEM OF ZnH AND ZnD IN THE FAR ULTRA-VIOLET REGION. M. Aslam Khan (Univ. of Karachi, Pakistan). Proc. Phys. Soc. (London), 80: 599-607(Sept. 1, 1962).

A new band system in ZnH, with its corresponding analogue in ZnD, at 2426.46 Å (0, 0 band) has been observed and analysed. The analysis showed that the transition is of the $C^2\Sigma \rightarrow X^2\Sigma$ type. The rotational lines observed (in absorption) are very diffuse and therefore it is concluded that the upper state is predissociated. It has been suggested that the predissociation is caused by a quartet state. The dissociation in this case will therefore lead to $^3P + {}^2S$ atom states. The rotational constants have been calculated. (auth)

3638 THE ARGON II SPECTRUM ENHANCED BY A MAGNETIC FIELD. E. H. Pinnington (Imperial Coll., London). Proc. Phys. Soc. (London), 80: 608-15(Sept. 1, 1962).

The spectrum of singly ionized argon was investigated using a 2450 Mc/s electrodeless discharge operated in a magnetic field of strength up to 24,000 gauss, and was found to be strongly enhanced by this field. Landé g-factors are given for energy levels based on the $3p^4(^3P)3d$ configuration in A II, for which close agreement with the theoretical values to be expected on the basis of LS coupling is found. (auth)

3639 SUM RULES FOR THE OSCILLATOR STRENGTHS OF H^-. A. Dalgarno and R. W. Ewart (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 80: 616-19(Sept. 1, 1962).

Recent theoretical and experimental values of the cross section for the photodetachment of the negative hydrogen

ion are checked for consistency with a number of sum rules. Attention is drawn to the unusually large cross sections to be expected for the photodetachment process in which the final state of the hydrogen atom is in the 2s state. (auth)

3640 LINEARIZATION OF THE EQUATIONS FOR AMBIPOLAR DIFFUSION. R. G. Fowler (Univ. of Oklahoma, Norman). Proc. Phys. Soc. (London), 80: 620-5 (Sept. 1, 1962).

The radial electric field in the positive column, which is needed to promote ambipolar diffusion, is shown to be given to a good approximation by a second-order linear differential equation as the next stage beyond the Schottky approximation. (auth)

3641 AMBIPOLAR DIFFUSION MEASUREMENTS IN LOW PRESSURE RARE GAS AFTERGLOWS. M. J. Mulcahy and J. J. Lennon (Univ. of Liverpool). Proc. Phys. Soc. (London), 80: 626-33(Sept. 1, 1962).

Microwave resonant cavity techniques have been used to investigate the afterglows of low pressure pulsed discharges in argon, helium, and neon. The values for the reduced mobilities of the various ions in their parent gases, derived from the ambipolar diffusion coefficients, disagree with previous microwave measurements but are in close agreement with the accepted drift tube values which cover a wide range of E/p. The mobilities of the various ions in their own gases were found to be He^+, 10.2; He_2^+, 20.3; Ne^+, 3.9; Ne_2^+, 7.5; Ar^+, 1.4; Ar_2^+, 2.6 $cm^2\ v^{-1}\ sec^{-1}$. The average energy of electrons and ions, during measurement, was 0.04 ev. Finally, diffusion cooling was observed in argon and neon. (auth)

3642 THE MOTION OF TEST CHARGES IN RAPIDLY OSCILLATING ELECTROMAGNETIC FIELDS. L. Bass (B.S.A. Group Research Centre, Birmingham, Eng.). Proc. Phys. Soc. (London), 80: 634-9(Sept. 1, 1962).

The motion of non-relativistic test charges is studied for a class of fields (arising, for example, in cavity resonators) which oscillate with a high frequency ω comparable with or greater than the local peak gyromagnetic frequency ω_g of the charges. Thus the recently developed methods based upon $\omega \ll \omega_g$ are supplemented whenever the (variable) magnetic field so confines the charges that the total field may be regarded as locally homogeneous. Rapidly converging expansions involving integral order Bessel functions $J_n(\omega_g/\omega)$ as coefficients are used to obtain asymptotic expressions for the kinetic energy limited by a simplified collision term in Lorentz's equations of motion. Kinetic energy resonances, reminiscent of the action of the betatron, arise for certain values of the critical ratio ω_g/ω, notably near the peaks of $[(\omega_g/\omega)J_1(\omega_g/\omega)]^2$. (auth)

3643 SOME EXPERIMENTS ON THE KAPITZA RESISTANCE BETWEEN METALS AND LIQUID HELIUM II. L. J. Challis (Univ. of Nottingham, Eng.). Proc. Phys. Soc. (London), 80: 759-67(Sept. 1, 1962).

Measurements have been made on the Kapitza boundary resistance between metals, principally lead, and liquid helium II. The results show that for the lead specimens investigated the resistance is larger in the superconducting state than in the normal state, decreases with magnetic field in the normal state and appears to increase with time. The results are discussed in terms of mechanisms suggested by Little in 1961. The increase with time is thought to be due to the formation of an oxide layer. Experiments to investigate changes in resistance with the state of anneal and the chemical impurity of specimens are somewhat inconclusive. (auth)

3644 RELATIVE EFFICIENCIES OF H_2O AND D_2O AS CATALYSTS FOR TRANSFER OF VIBRATIONAL ENERGY. J. C. McCoubrey, R. C. Milward, and A. R. Ubbelohde (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), Ser. A, 269: 456-68(Oct. 9, 1962).

Complex theories of transfer from translational to internal energy in gaseous collisions can be tested in an accurate and fairly simple way, by comparing catalytic efficiencies of transfer by the isotopic molecules H_2O and D_2O. Results are given for experiments with the vibrators N_2O, CO_2, SO_2, CH_3Cl, C_2H_4, and cyclopropane. The ratio of efficiencies conforms with the ratio of the masses of H_2O and D_2O for C_2H_4, and within the limits of error for CH_3Cl, but not for the other vibrators. With each of these molecules, in different ways, more than one catalytic mechanism appears to be operative for the transfer of internal energy. (auth)

3645 OXYGEN-17 NUCLEAR MAGNETIC RESONANCE OF INORGANIC COMPOUNDS. B. N. Figgis, R. G. Kidd, and R. S. Nyholm (University Coll., London). Proc. Roy. Soc. (London), Ser. A, 269: 469-80(Oct. 9, 1962).

The O^{17} chemical shifts of a number of compounds were measured at 6.000 Mc in the liquid or solution state. The resonances observed for the 'closed-shell' oxy-anions of the transition metals indicate a high degree of paramagnetic shielding of the oxygen nuclei for these anions. A linear relationship was observed between the chemical shifts for these anions and their lowest-energy electronic transitions as obtained from uv and visible spectra. Calculations in terms of a molecular orbital model for these anions successfully accounted for this relationship and at the same time produced a mechanism for the observed paramagnetic shielding. It is shown that a similar linear relationship exists in the cases of organic carbonyl compounds for which nuclear resonance and optical spectral data are available. (auth)

3646 AN EXPANSION METHOD FOR CALCULATING ATOMIC PROPERTIES. [PART] II. M. Cohen, A. Dalgarno, and J. M. McNamee (Queen's Univ., Belfast). Proc. Roy. Soc. (London), Ser. A, 269: 550-9(Oct. 9, 1962).

The accuracy of the methods of calculating the expectation values of perturbed atomic systems is analyzed by means of an expansion in inverse powers of the nuclear charge. Results are presented for the quadrupole polarizabilities and nuclear-shielding factors of all members of the helium and beryllium isoelectronic sequences and it is shown that the loss of accuracy entailed in replacing the full self-consistent method by a simpler one is small. An estimate is made of the importance of configuration interaction between the $(1s^22s^2)\,^1S$ and $(1s^22p^2)\,^1S$ states of the beryllium sequence. (auth)

3647 HIGH EFFICIENCY LOW-PRESSURE ION SOURCE. C. E. Carlston and G. D. Magnuson (General Dynamics/Astronautics, San Diego, Calif.). Rev. Sci. Instr., 33: 905-11(Sept. 1962).

A magnetically confined, oscillating electron bombardment source has been designed which delivers high currents of noble gas ions, in the 1- to 10-kev energy range. The energy spread of the beam was 2 ± 1 ev using an anode potential of 45 v. Pressure in the source chamber was measured during source operation so that accurate gas efficiency measurements could be made. The optimum gas efficiency obtained for argon at 5-kv extraction potential and an operating pressure of 4×10^{-4} Torr was 59%. Mass analysis of source output showed that when the source was operated with research grade argon (99.999% pure) impurity ions in the beam consisted of only 0.50% N_2^+, 0.75% O_2^+, 0.75% H_2O^+, and 0.70% Ar^{2+}. Filament life is extremely long, well over 750 h. Analysis of ion production rate and

plasma density shows that a large contribution to electron emission is made by the secondary electrons produced at the tungsten filament due to positive ion bombardment. The secondary electron emission current was found to be as much as 30% of the true thermionic emission current and is not negligible as previous investigators have assumed. (auth)

3648 AN INTRODUCTION TO SPIN-SPIN SPLITTING IN HIGH-RESOLUTION NUCLEAR MAGNETIC RESONANCE SPECTRA. J. D. Roberts. New York, W. A. Benjamin Publishers Inc., 1961. 116p. $4.95.

3649 DISPERSION CORRECTIONS FOR ATOMIC SCATTERING FACTORS. David Templeton. p.213-16 of "International Tables for X-ray Crystallography (Physical and Chemical Tables), Volume III." Birmingham, Eng., Kynoch Press, [1962]. (UCRL-9146)

The atomic scattering factor may be represented as a complex number, with real and imaginary dispersion corrections, in order to allow for the possibility that the scattering power of bound electrons may be different from that of free electrons. Dispersion corrections for various wavelengths are tabulated for the elements of atomic numbers from 5 to 96. (D.L.C.)

3650 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY, 1962 WINTER MEETING, WASHINGTON, D. C., NOVEMBER 26-28, 1962. Malcolm D. Ferrier, ed. Trans. Am. Nucl. Soc., 5: No. 2, 273-491(Nov. 1962).

Summaries of 259 papers are included; the title of each is listed in NSA. For the users convenience all titles have been listed in this subject category. Where other subject categories would be more appropriate, cross references have been used. Complete author and subject indexes have been prepared. In the event the complete papers are published later, they will be announced in NSA. (D.E.B.)

3651 ANALYTICAL AND CONTROL PROBLEMS IN HYDROLOGY POSSIBLY AMENABLE TO RADIOISOTOPE TECHNIQUES. Luna B. Leopold (Geological Survey, Oak Ridge, Tenn.). Trans. Am. Nucl. Soc., 5: 273(Nov. 1962).

3652 A RADIO-RELEASE TECHNIQUE FOR TRACING SURFACE WATER. Arthur S. Gillespie, Jr. and Harold G. Richter (Research Triangle Inst., Durham, N. C.). Trans. Am. Nucl. Soc., 5: 273(Nov. 1962).

3653 TOTAL-COUNT FLOW MEASUREMENTS IN WATER RESOURCES RESEARCH. D. E. Hull (California Research Corp., Richmond, Calif.). Trans. Am. Nucl. Soc., 5: 273-4(Nov. 1962).

3654 DETERMINATION OF FLOW THROUGH TURBINES. Bernard J. Frederick (Geological Survey, Oak Ridge, Tenn.). Trans. Am. Nucl. Soc., 5: 274-5(Nov. 1962).

3655 THE USE OF RADIOISOTOPES IN THE STUDY OF GROUND-WATER MOTION. Herbert E. Skibitzke (Geological Survey, Denver). Trans. Am. Nucl. Soc., 5: 275(Nov. 1962).

3656 USE OF GAMMA AND NEUTRON SOURCES IN MEASURING HYDROLOGIC CHARACTERISTICS OF SNOW. Henry W. Anderson, Philip M. McDonald, and Lloyd W. Gay (U. S. Dept. of Agriculture, Berkeley, Calif.). Trans. Am. Nucl. Soc., 5: 275-6(Nov. 1962).

3657 MEASUREMENT OF THE LIQUID/SOLID RATIO IN NATURAL WATERS. L. L. Bird, R. H. Maehl, and C. A. Ziegler (Parametrics, Inc., Waltham, Mass.). Trans. Am. Nucl. Soc., 5: 276(Nov. 1962).

3658 AN ULTRASENSITIVE ANALYZER FOR MEASURING SPEED OF WATER CURRENTS. William A. Johnston, H. P. Yule, and J. H. Carpenter (William H. Johnston Labs., Baltimore). Trans. Am. Nucl. Soc., 5: 276-7(Nov. 1962).

3659 THE MEASUREMENT OF OXYGEN IN THE MARTIAN ATMOSPHERE VIA KRYPTONATES. David Chleck (Parametrics, Inc., Waltham, Mass.). Trans. Am. Nucl. Soc., 5: 278(Nov. 1962).

3660 THE USE OF NUCLEAR-ACTIVATION ANALYSIS TO DETERMINE THE ELEMENTAL COMPOSITION OF THE MOON'S SURFACE. Morris B. Lee, Edward Ibert, Lloyd E. Fite, and Richard E. Wainerdi (Agricultural and Mechanical Coll. of Texas, College Station). Trans. Am. Nucl. Soc., 5: 278-9(Nov. 1962).

3661 DETECTION OF MICROORGANISMS ON OTHER PLANETS. Gilbert V. Levin, Allen H. Heim, and Mary-Frances Thompson (Resources Research, Inc., Washington, D. C.). Trans. Am. Nucl. Soc., 5: 279(Nov. 1962).

3662 MEASUREMENT OF ATMOSPHERIC DENSITY USING BETA-RAY SCATTERING. L. L. Bird and C. A. Ziegler (Parametrics, Inc., Waltham, Mass.). Trans. Am. Nucl. Soc., 5: 280(Nov. 1962).

3663 A COMMERCIAL APPLICATION OF NUCLEAR ACTIVATION ANALYSIS TO THE STUDY OF AIR POLLUTION. Seymour Tarras and Othel L. Pirtle, Jr. (Tracerlab, Inc., Richmond, Calif.). Trans. Am. Nucl. Soc., 5: 280 (Nov. 1962).

3664 METEOROLOGICAL INFLUENCES UPON Sr-90 FALLOUT IN PRECIPITATION. Paul Kruger and Charles L. Hosler (Hazleton Nuclear Science Corp., Palo Alto, Calif.). Trans. Am. Nucl. Soc., 5: 281(Nov. 1962).

3665 PRODUCTION-LINE UTILIZATION OF RADIOISOTOPE TECHNIQUES IN THE AEROSPACE INDUSTRY. Seymour Tarras and J. B. Fishman (Tracerlab, Inc., Richmond, Calif.). Trans. Am. Nucl. Soc., 5: 281(Nov. 1962).

3666 SOME FORENSIC PROBLEMS AMENABLE TO RADIOISOTOPE TECHNIQUES. Paul L. Kirk (Univ. of California, Berkeley). Trans. Am. Nucl. Soc., 5: 282(Nov. 1962).

3667 DETECTION OF GUNPOWDER RESIDUES BY NEUTRON ACTIVATION ANALYSIS. R. R. Ruch (General Atomic Div., General Dynamics Corp., San Diego, Calif.), V. P. Guinn, and Ray H. Pinker. Trans. Am. Nucl. Soc., 5: 282(Nov. 1962).

3668 THE APPLICATION OF NEUTRON-ACTIVATION ANALYSIS TO INDIVIDUAL IDENTIFICATION. G. W. Leddicotte, W. J. Ross, and J. F. Emery (Oak Ridge National Lab., Tenn.). Trans. Am. Nucl. Soc., 5: 282-3(Nov. 1962).

3669 THE USE OF NEUTRON-ACTIVATION ANALYSIS IN FORENSIC SCIENCE. L. C. Bate (Oak Ridge National Lab., Tenn.), J. F. Emery, G. W. Leddicotte, and M. J. Pro. Trans. Am. Nucl. Soc., 5: 283(Nov. 1962).

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3898 A 6400-HOUR TEST OF A NITROGEN-COOLED HIGH-TEMPERATURE FUEL ELEMENT. H. T. Watanabe, G. T. Geering, and J. S. Brunhouse (Aerojet-General Nucleonics, San Ramon, Calif.). Trans. Am. Nucl. Soc., 5: 484(Nov. 1962).

3899 A SIMULATED SUPERHEAT-REACTOR CORROSION FACILITY. M. D. Fitzsimmons, W. L. Pearl, and M. Siegler (General Electric Co., Pleasanton, Calif.). Trans. Am. Nucl. Soc., 5: 485(Nov. 1962).

3900 FUEL CLADDING CORROSION TESTING IN SIMULATED SUPERHEAT-REACTOR ENVIRONMENT PHASE. I. GENERAL CORROSION, TYPE 304 STAINLESS STEEL. G. G. Gaul and W. L. Pearl (General Electric Co., Pleasanton, Calif.). Trans. Am. Nucl. Soc., 5: 485-6(Nov. 1962).

3901 WATER DECOMPOSITION BY FISSION FRAGMENT RECOIL ENERGY IN AN AQUEOUS SLURRY OR URANIUM–THORIUM OXIDES. Lawrence R. Steele (Argonne National Lab., Ill.), Sheffield Gordon, and Charles E. Dryden. Trans. Am. Nucl. Soc., 5: 486(Nov. 1962).

3902 TITANIUM-NITRIDE-BASE COMPOSITIONS FOR USE IN WATER REACTORS. Ervin Colton and Dean A. Nehrig (Allis Chalmers Mfg. Co., Milwaukee). Trans. Am. Nucl. Soc., 5: 487(Nov. 1962).

3903 FOAMED BERYLLIA AS A HIGH-TEMPERATURE THERMAL INSULATOR. A. D. Feith and W. G. Baxter (General Electric Co., Cincinnati). Trans. Am. Nucl. Soc., 5: 487-8(Nov. 1962).

3904 BORON SILICIDE . . .A PROMISING NEW CONTROL MATERIAL. D. A. Nehrig and E. Colton (Allis-Chalmers Mfg. Co., Milwaukee). Trans. Am. Nucl. Soc., 5: 488(Nov. 1962).

3905 DEVELOPMENT AND EVALUATION OF HIGH N_H METALLIC HYDRIDES OF ZIRCONIUM (N_H 6.0–6.6) AND TITANIUM (N_H 5.5–5.8). R. Van Houten and W. G. Baxter (General Electric Co., Cincinnati). Trans. Am. Nucl. Soc., 5: 488(Nov. 1962).

3906 YTTRIUM HYDRIDE MODERATOR EVALUATION: IN-PILE THERMAL STABILITY. J. C. Marshall, R. Van Houten, and W. G. Baxter (General Electric Co., Cincinnati). Trans. Am. Nucl. Soc., 5: 489(Nov. 1962).

3907 CONCRETE FOR REACTOR HOUSING CONSTRUCTION. R. L. Koontz, C. T. Nelson, and S. E. Becker (Atomics International, Canoga Park, Calif.). Trans. Am. Nucl. Soc., 5: 489-91(Nov. 1962).

Astrophysics and Cosmology

3908 (RM-3096-PR) IDEALIZED SHEATH THEORY AND SATELLITE CHARGE-UP IN THE VAN ALLEN REGION. G. E. Modesitt (RAND Corp., Santa Monica, Calif.). Apr. 1962. Contract AF49(638)-700. 32p. (AD-274599)

As an aid in the determination of the electric potential of naturally charged satellites, the concept of the idealized sheath introduced by Langmuir and Mott-Smith is studied in some detail through the use of distribution functions. It is shown that the functions are discontinuous in velocity variables and lead to the same results as particle trajectory theory. The limitations of the sheath theory and its connection with space-charge-limited diode theory are discussed. It is shown that, under certain assumptions, the potential on a satellite whose diameter is smaller than the local Debye length will reach 3500 volts negative in the more intense regions of the Van Allen electron belt. The equilibrium potential decreases with increasing size of the satellite, with a limiting value of –35,000 volts for satellites much greater than the Debye length in diameter. (auth)

3909 (TID-13994) AN ALTERNATE TEST OF "BAILEY'S HYPOTHESIS." Robert W. Bussard (Los Alamos Scientific Lab., N. Mex.). July 18, 1961. Contract [W-7405-eng-36]. 3p. (LADC-4981)

It was suggested by Bailey that the sun carries a net electric charge and that this charge can be deduced by use of magnetometers on board Pioneer V. If the Coulomb interaction between the sun and a charged test body moving in a heliocentric orbit is sufficiently strong relative to the gravitational forces, significant deviations of the body from a Keplerian orbit may be observed, and the solar charge deduced directly from measurement of these deviations and knowledge of the test body charge. (M.C.G.)

3910 (FTD-TT-62-99) AN INVESTIGATION OF MAGNETIC FIELDS ASSOCIATED WITH SOLAR FLARES. A. B. Severny (Severnyy). Translated from Izv. Krymsk. Astrofiz. Observ., No. 22, 12-41(1960). 46p.

Studies were made of the occurrence of solar flares at neutral points in a magnetic field and on the destruction, by the flares, of the magnetic fields surrounding these points. Using a solar magnetograph, 20 recordings of magnetic fields of active groups were obtained. A comparison of the positions of the main, most intense, flare foci at the instant of their appearance with the positions of neutral points in 61 cases showed that in 46 cases the flares appear practically at the neutral points, in 8 cases the discrepancy in positions can be attributed to errors, and in 7 cases the discrepancy exceeds the errors. A comparison of the magnetic-field charts obtained before and after the flares, showed that in 7 cases out of 8, the magnetic fields tend to be simpler after the flare and in the vicinity of the flares the magnetic fields are destroyed. (M.C.G.)

3911 ON PARA- AND ORTHOHYDROGEN MOLECULES IN INTERSTELLAR SPACE. D. E. Osterbrock (Univ. of Wisconsin, Madison). Astrophys. J., 136: 359-62(Sept. 1962).

The relative amounts of para- and orthohydrogen in interstellar space are estimated. These depend on transition probabilities between successive rotational levels in the ground electronic and vibrational state of the H_2 molecule. The probability of the radiative transition $2 \rightarrow 1$ is so much larger than the probability of the quadrupole transition $2 \rightarrow 0$ that nearly every molecule that is excited to the level $J = 2$ goes down to $J = 0$ via $J = 1$. The rates of conversion between para- and orthohydrogen by this process are estimated, and it is shown that, though the equilibrium amount of ortho-hydrogen is small, its presence could in principle be detected observationally by its far-infrared line emission. (auth)

3912 STUDIES OF THE PECULIAR A STARS. I. THE OXYGEN-ABUNDANCE ANOMALY. Wallace L. W. Sargent and Leonard Searle (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Astrophys. J., 136: 408-21(Sept. 1962).

Equivalent widths of the infrared oxygen blends λλ 7772–7775 and λ 8446 have been measured in 20 peculiar A stars and 3 A-type normal stars. The neighboring pair of Mg II lines at λ 7877 and λ 7896 have also been measured. Both the O I and Mg II lines are quite insensitive to temperature and electron pressure and in normal stars behave almost identically in the range B8-F5. The oxygen lines are very much weaker in some peculiar stars than in the standard stars; this effect is strongly correlated with the B – V color. The Mg II lines show no comparable trend. The results are interpreted as indicating abundance variations among the Ap stars. Oxygen is deficient with respect to hydrogen by factors ranging from 8 to more than 100 in all Ap stars of the Si–Eu–Cr, Eu-Cr, Eu–Cr–Sr, and Sr classes, while in the Mn stars the oxygen abundance is normal. Assuming that they originated with a normal composition, the observed spectra of the oxygen-deficient Ap stars demand that, in general, O must have been transmuted into one or more of the elements H, He, C, N, Ne, and perhaps F. Some possible nuclear reactions (which must involve only H, He, and O^{16}) that could be responsible for the inferred oxygen deficiency are discussed. (auth)

3913 THE EXCLUSION PRINCIPLE AND PHOTOBETA REACTIONS IN NUCLEOGENESIS. John N. Bahcall (Indiana Univ., Bloomington). Astrophys. J., 136: 445-52 (Sept. 1962).

The effects of the exclusion principle and photobeta reactions on the formation of heavy elements by slow neutron capture are discussed. It is shown that a measurement of the isotopic abundance of Zr^{93} in giant stars exhibiting technetium lines would permit inferences concerning the temperature of the nuclear reacting core in which the heavy elements were produced. (auth)

3914 THE MEAN LIFETIMES OF CARBON, NITROGEN, AND OXYGEN NUCLEI IN THE CNO BI-CYCLE. Georgeanne R. Caughlan (Montana State Coll., Bozeman) and William A. Fowler. Astrophys. J., 136: 453-64(Sept. 1962).

An analysis is made of recent experimental data on the seven-proton reactions of the CNO bi-cycle. The mean lifetimes in years for the nuclei C^{12}, C^{13}, N^{14}, N^{15}, O^{16}, and O^{17} in hydrogen-burning are given in the form of a table of $\log \tau\rho x_H/100$ over the temperature range $5 \times 10^6 - 100 \times 10^6$ degrees. The characteristic mean lifetime of the entire double cycle is also given. Beta decay lifetimes are neglected but can be included in individual cases without difficulty. Under equilibrium conditions at all temperatures, the bi-cycle essentially processes input nuclei, such as C^{12} or O^{16}, primarily into N^{14}. The time scale for the approach to equilibrium is long (>10^9 years) for O^{16} at $T \leq 17 \times 10^6$ degrees and for C^{12} at $T \leq 10 \times 10^6$ degrees. For $T \geq 100 \times 10^6$, the nature of the reactions involved changes considerably. (auth)

3915 THE TRANSITION FROM HYDROGEN-BURNING TO HELIUM-BURNING IN A STAR OF 5 SOLAR MASSES. Emil J. Polak (Princeton Univ., N. J.). Astrophys. J., 136: 465-75(Sept. 1962).

The evolution of an early main-sequence star of 5 solar masses with an assumed composition is considered. Twenty-one evolutionary models are developed, taking the star from the initial main-sequence model to states with a hydrogen-exhausted core and, finally, to a point where the core contraction causes the central temperature to race upward toward conditions required for helium-burning. It is found that the convective core steadily decreases and ultimately vanishes when the hydrogen content at the star's center reaches zero. At this phase the location of the hydrogen-burning undergoes a rapid transition from a core source to a shell source. The core exhausted of hydrogen approaches an isothermal state for a short while. Contraction then becomes decisive for the core, and the central temperature quickly rises to the point at which helium-burning begins. The S-shaped evolution track in the Hertzsprung-Russell diagram characteristic of the phases here covered is derived in detail. (auth)

3916 THE Hα LINE IN THE FLARE OF NOVEMBER 12, 1960. Richard G. Teske (Univ. of Michigan, Ann Arbor). Astrophys. J., 136: 534-45(Sept. 1962).

Spectra of the Hα line in the 3+ flare of November 12, 1960, have been analyzed. The width and central intensity of the line, the optical thickness of the flare, and its rate of radiation in Hα are comparable to values measured in other 3+ flares. No spectroscopic evidence for deuterium has been found. (auth)

3917 IONIZATION-EQUILIBRIUM EQUATION OF STATE. III. RESULTS WITH DEBYE-HUCKEL CORRECTIONS AND PLANCK'S PARTITION FUNCTION. Carl A. Rouse (Univ. of California, Livermore). Astrophys. J., 136: 636-64(Sept. 1962). (UCRL-5695-T(Pt. 4))

The complete solution to Saha's equation has been corrected by the simultaneous computation of the Debye-Hückel correction to the ionization potentials and Planck's theoretical partition functions. Results are given for hy-

drogen, helium, lithium, and carbon in a temperature-density region of stellar interest. It is shown that an ionization-equilibrium equation of state with Debye-Hückel corrections and Planck's partition functions is quite adequate for the study of atmospheres and interiors of non-degenerate or slightly degenerate stars and the atmospheres and envelopes of degenerate stars. (auth)

3918 ON CHAMBERLAIN'S THEORY OF AURORAL BOMBARDMENT. K. D. Cole (Dept. of External Affairs, Melbourne). Astrophys. J., 136: 677-8(Sept. 1962).

One application of Chamberlain's theory of auroral bombardment (Chamberlain, J. W. 1961, Ap. J., 134: 401) is to the explanation of auroral rays. It is suggested that whereas the theory is relevant to the macroscopic polar ionospheric disturbance, it is not capable of explaining ray structure. (W.D.M.)

3919 THEORY OF AURORAL BOMBARDMENT. SUPPLEMENTARY REMARKS. Joseph W. Chamberlain (Univ. of Chicago). Astrophys. J., 136: 678-81(Sept. 1962).

Cole's comments (Cole, K. D. 1962, Ap. J., 136: 677) on Chamberlain's theory of auroral bombardment (Chamberlain, J. W. 1961, Ap. J., 134: 401) are discussed and the mechanism is modified somewhat. It is concluded that this modified mechanism may, with sufficient density irregularities occurring radially in the energetic part of the plasma, respond rapidly enough to produce bombardment before ionospheric charges neutralize the potential. (W.D.M.)

3920 RAYLEIGH SCATTERING BY MOLECULAR HYDROGEN. A. Dalgarno and D. A. Williams (Queen's Univ., Belfast). Astrophys. J., 136: 690-2(Sept. 1962).

By an extension of the methods of Dalgarno and Kingston (Dalgarno, A., and Kingston, A. E. 1960, Proc. R. Soc. London, A, 259: 424), the Rayleigh scattering cross section of molecular hydrogen was calculated for wavelengths greater than 1200 Å. The wavelength dependence and the Planck mean for the Rayleigh scattering cross sections of H_2 at different temperatures are shown. (W.D.M.)

3921 CHARGE DRAG ON PROJECT WEST FORD NEEDLES. David B. Beard (Univ. of California, Davis and Lockheed Missiles and Space Co., Palo Alto, Calif.). J. Geophys. Research, 67: 3293-7(Aug. 1962).

The electrical potential surrounding pieces of wire in the ionosphere is computed assuming photoemission is negligible and is shown to depend essentially logarithmically on distance at small distances from the needle and exponentially on distance at distances of the order of the Debye length for the medium. The resulting drag due to the Coulombic deflection of hydrogen ions is probably an order of magnitude greater than neutral drag at the proposed altitude of 3700 km. At 300 km altitude the greater mass of the ambient O^+ ions, the higher electron density, and the lower degree of ionization cause charge drag to be a completely negligible effect. (auth)

3922 A COMPARISON OF SOLAR FLARE INCIDENCE WITH MAGNETIC TRANSIENTS OBSERVED IN THE NEARBY INTERPLANETARY REGION BY PIONEER 5. E. W. Greenstadt (Space Technology Labs., Redondo Beach, Calif.) and G. E. Moreton. J. Geophys. Research, 67: 3299-3316 (Aug. 1962).

A study of magnetometry data collected from solar satellite Pioneer 5 is described, showing that the temporal fluctuations in ambient field magnitude that characterized the data were correlated in time with the occurrence of moderate to strong Hα flare activity on the visible solar disk. The results of efforts to identify specific flare-disturbance pairs and to calculate propagation velocities from them are included, the minimal size of effective flares appearing to be three to five square degrees in area, and corresponding sun to satellite velocities falling in the range 750 to 1140 km/sec. It is found that some field perturbations, apparently flare-induced and detectable outside the magnetosphere but near the earth, could not be correlated with any apparent effect on the surface geomagnetic field, that disturbance vectors were probably not confined to any single quasi-radial orientation with respect to the sun, and that disturbance amplitudes, which varied between 50 and 500 microgauss, may be directly related to the size of their originating flares. (auth)

3923 HYDROMAGNETIC EMISSIONS, X-RAY BURSTS, AND ELECTRON BUNCHES. 1. EXPERIMENTAL RESULTS. L. R. Tepley and R. C. Wentworth (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Geophys. Research, 67: 3317-33(Aug. 1962).

Recent experimental results are presented concerning the occurrence, structure, and frequency-latitude dependence of hydromagnetic emissions (regular oscillatory micropulsations in the frequency range 0.4–7 cps). Results are also presented for the occurrence of noise bursts (irregular micropulsations in the same frequency range). Evidence is considered suggesting that both hm emissions and noise bursts are generated by related mechanisms. The experimental results are summarized as follows: (1) Occurrence. First, short hm emission bursts sometimes occur about 1 min after the sudden commencement of magnetic storms. Second, simultaneous occurrence with x-ray bursts and increased riometer absorption has been noted. (2) Structure. Hydromagnetic emissions tend to occur in distinct frequency bands. The bands are usually characterized by a fine structure consisting of a superposition of repetitive wave trains of a few minutes' duration and rapidly increasing frequency. (3) Frequency-latitude dependence. An inverse relationship has been found between the highest observed hm emission frequency and the geomagnetic latitude at which the signal is observed. (auth)

3924 HYDROMAGNETIC EMISSIONS, X-RAY BURSTS, AND ELECTRON BUNCHES. 2. THEORETICAL INTERPRETATION. R. C. Wentworth and L. R. Tepley (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Geophys. Research, 67: 3335-43(Aug. 1962).

The existence of bunches of monoenergetic electrons oscillating back and forth along field lines in the magnetosphere has been suggested by a number of workers to explain various geophysical phenomena. The simultaneous occurrence of x-ray and hydromagnetic emission bursts (regular oscillatory micropulsations at frequencies in the range 1–2 cps) immediately after sudden commencements and during magnetically disturbed periods, as discussed in part 1, raises the possibility that hm emissions could be generated by such electron bunches. A model is presented that considers certain aspects of the motion of geomagnetically trapped electrons relevant to the production of hm emissions by electron bunches. A new result is the calculation of electron motion in a dipole field confined to the interior of a sphere (as a first approximation to the solar wind cavity). The model calculations are applied to experimental results discussed in part 1, and it is shown that the electrons responsible for the x-ray burst after the sudden commencement of June 27, 1960, could have produced the hm emission burst at that time, and that the maximum observed hm emission frequency as a function of geomagnetic latitude is consistent with the calculated value. Hydromagnetic emissions during magnetically quiet times are characterized by a fine structure containing overlapping bands of rapidly increasing frequency. This is tentatively interpreted as indicating rapid acceleration of electron bunches;

hence, if the model is correct, hm emissions will provide a powerful tool for studying the acceleration mechanism for electrons in the magnetosphere. (auth)

3925 THE TEMPERATURE OF METEORITES AND DIRAC'S COSMOLOGY AND MACH'S PRINCIPLE. J. Peebles and R. H. Dicke (Princeton Univ., N. J.). J. Geophys. Research, 67: 4063-70(Sept. 1962).

Arguments based on Mach's principle and on numerical coincidences in the astrophysical data lead to the idea that the strength of the gravitational interaction may be decreasing with time. This would imply that the radiation rate of the sun was larger in the past and that asteroids and meteorite bodies were warmer, possibly leading to loss of argon from the material of the meteorites. It is shown from the observed potassium–argon ages of meteorites that the strength of the gravitational interaction has not been decreasing by more than about 1 part in 10^{10} per year. This limit does not seem to rule out any of the cosmologies in which the strength of the gravitational interaction is variable. (auth)

3926 DENSITY IN A SIMPLE MODEL OF THE EXOSPHERE. R. E. Aamodt and K. M. Case (Univ. of Michigan, Ann Arbor). Phys. Fluids, 5: 1019-21(Sept. 1962).

The particle density of a simple model of the exosphere is obtained by solving exactly the collisionless Boltzmann equation. The main point of the solution is that it is a discontinuous, multivalued function of the constants of motion. Results, of course, agree with those of other methods based on Newtonian mechanics. (auth)

3927 COSMOLOGY AND THE RADIOACTIVE DECAY AGES OF TERRESTRIAL ROCKS AND METEORITES. P. J. Peebles and R. H. Dicke (Princeton Univ., N. J.). Phys. Rev., 128: 2006-11(Dec. 1, 1962). (PUC-1962-73)

Several different cosmologies have been proposed in which the strength of the gravitational interaction is variable. Also, it has been suggested that the gravitational interaction may play a significant role in determining the structure of elementary particles, and in particular that the value of the fine structure constant may depend on the strength of the gravitational interaction. It is shown that these two effects taken together would lead to observable discrepancies in the ages of terrestrial rocks and meteorites as determined by different radioactive decay schemes. Analysis of the geophysical data leads to an upper limit of about 3 parts in 10^{13} per year on the rate of change of the fine structure constant. If the assumed relation between gravitation and particle structure were valid, this would correspond to a limit on variations in the strength of the gravitational interaction of 2 parts in 10^{11} per year. This upper limit is one-fifth of the size of the variations expected according to Dirac's cosmology, and roughly as big as the variation to be expected according to the Brans-Dicke cosmology. It is concluded that either the assumed connection between gravitation and elementary particles does not exist, or if the connection does exist, that the geophysical data provide a significant limit on possible variations in the strength of the gravitational interaction. (auth)

3928 TEST OF POSSIBLE VARIATIONS OF THE GRAVITATIONAL CONSTANT BY THE OBSERVATION OF WHITE DWARFS WITHIN GALACTIC CLUSTERS. Arrigo Finzi (Università, Rome). Phys. Rev., 128: 2012-15(Dec. 1, 1962).

An astronomical test is suggested for the hypothesis that the gravitational constant k varies throughout space-time according to the law $k = k_0(1 + aV/c^2)$, where a is a dimensionless constant of the order of unity and V is the gravitational potential. If k varies, the gravitational self-energy of a body also varies. This brings about a correction in the gravitational force which, in the case of a very dense and massive body like a white dwarf, is not completely negligible. In the gravitational field of the Galaxy, the path of a white dwarf will be slightly different from that of a normal star. In consequence, a white dwarf in a very weakly bound cluster will escape; a white dwarf in a more strongly bound cluster will occupy an anomalous position. Testing these predictions seems to be within the limits of present-day possibilities. (auth)

Cosmic Radiation

Refer also to abstract 3198.

3929 (AD-273627) RESULTS OF BALLOON FLIGHTS FOR COSMIC RADIATION MEASUREMENTS AT WEISSENAU AND LINDAU (GERMANY). Technical Note No. 3. H. Erbe (Max-Planck-Institut für Aeromonie. Institut für Stratospharenphysik, Lindau/Harz, Germany). Dec. 31, 1961. Contract AF61(052)-372. 23p.

The results of 10 balloon flights with counter telescopes and of 24 flights with single counters are presented. It was found that a nearly unique correlation exists between the counting rate in a certain altitude and the counting rate of the neutron monitor on ground if only galactic radiation impinges at the top of the atmosphere. The counting rates of the single counter scatter in a more pronounced manner with respect to the average expectation values related to the neutron counting rates than those of the telescope. This is considered to be the result of meson decay along the very extended paths traversed by particles arriving from strongly inclined directions. These are accepted by the single counter with its larger aperture in contrast to the telescope which responds only to particles arriving in a narrower cone centered around the vertical. (auth)

3930 (AFCRL-62-652) GEOPHYSICAL ASPECTS OF COSMIC RAYS. Final Report. Arne Eld Sandstroem (Uppsala Univ. Inst. of Physics). Mar. 31, 1962. Contract AF(514)-1312. 23p.

Data collected at Swedish cosmic radiation stations are presented for further research on harmonic analysis of the yearly mean daily variation and for the mean daily variations for other periods of interest. The data were collected also for use in other studies. Information is included on cosmic radiation station equipment, atmospheric effects, standard errors, direction of cosmic ray anisotropy, cosmic ray storms, solar flare effects, and diurnal variations. (J.R.D.)

3931 (AFCRL-1089) HIGH ENERGY INTERACTIONS OF COSMIC RAY PARTICLES: NUCLEAR EVENTS INDUCED BY HEAVY PRIMARIES AND THEORY OF MESON PRODUCTION IN HIGH ENERGY COLLISIONS. Final Technical Report. Gideon Yekutieli (Weizmann Inst. of Science, Rehovoth, Israel). Sept. 30, 1961. Contract AF61(052)-371. 73p.

Results of investigations concerning a theory of meson production based on the two fire balls models are reported. Calculations concerning the reaction cross section in N-nucleus and nucleus-nucleus collisions are also reported along with experimental results on meson production and fragmentation induced by heavy cosmic-ray primaries. (J.R.D.)

3932 THE HYDROGEN COMPONENT IN THE PRIMARY COSMIC RADIATION. H. H. Aly (National Research Council, Ottawa). Can. J. Phys., 40: 1049-55(Sept. 1962). (NRC-6934)

Two values for the flux of the hydrogen component in the primary cosmic radiation have been measured. The first one was over Guam in the Marianas Islands, geomagnetic latitude $\lambda = 0°$. The value of the flux was found to be (123 ± 12) hydrogen nuclei/m^2 sterad sec. The second measurement was made over Texas, $\lambda = 41°N.$, and the value found was (530 ± 53) hydrogen nuclei/m^2 sterad sec. The detectors in both cases were stacks of nuclear emulsion exposed at high altitude. The results obtained in this experiment are in good agreement with the values obtained by the others using electronic counters flown at the same geomagnetic latitudes. (auth)

3933 SOLAR COSMIC RAYS OF JULY 1961 AND THEIR IONOSPHERIC EFFECTS. B. Maehlum and B. J. O'Brien (State Univ. of Iowa, Iowa City). J. Geophys. Research, 67: 3269-79(Aug. 1962).

The temporal and spatial variations of the energy spectrum of the solar protons of energies $0.5 < E < 60$ Mev as observed by the particle detectors in the State University of Iowa satellite Injun 1 during July 1961 have been studied. The variations in the electron density in the lower ionosphere to be expected from the observed proton flux are in good agreement with the observed variations in the ionosphere at high latitudes during the same period. The difference in the polar-cap absorption as observed during the two different types of solar proton events during July 1961 are discussed. (auth)

3934 NOTE ON THE ELECTRON ENERGY SPECTRUM IN THE INNER VAN ALLEN BELT. G. Pizzella, C. D. Laughlin, and B. J. O'Brien (State Univ. of Iowa, Iowa City). J. Geophys. Research, 67: 3281-7(Aug. 1962).

The energy spectrum of trapped electrons predicted by the neutron-albedo theory was tested experimentally with a magnetic electron spectrometer for the energy range $40 \leq E \leq 110$ kev. This detector was flown on the State University of Iowa research satellite Injun I at an altitude of about 1000 km in the inner radiation zone over South America. Another detector on the same satellite measured the directional intensity of electrons with $E \geq 40$ kev. The data are consistent with a peak directional intensity of electrons in this region of $N(E) \sim 10^4 \exp(-E/160)$ particles $(cm^2 \text{ sec ster kev})^{-1}$, or with a power-law spectrum with a differential exponent of $-(1.0 \pm 0.2)$ for $40 \leq E \leq 110$ kev. This result is significantly in disagreement with the predictions of the neutron-albedo theory. (auth)

3935 RE-ENTRANT COSMIC-RAY ALBEDO. Ernest C. Ray (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Research, 67: 3289-91(Aug. 1962).

Secondary products of the interaction of cosmic rays with the earth's atmosphere, when projected upward and when of an energy below the Störmer cutoff, are trapped by the earth's magnetic field and guided to an impact with the atmosphere in the hemisphere opposite that of their formation. These particles are called the re-entrant albedo. An expression is derived for their intensity and a simplified computation of a particular case where data are available for comparison is made. (auth)

3936 ELECTRON-DENSITY VARIATIONS IN THE MAGNETOSPHERE DEDUCED FROM WHISTLER DATA. D. L. Carpenter (Stanford Univ., Calif.). J. Geophys. Research, 67: 3345-60(Aug. 1962).

Electron density variations in the magnetosphere at a geocentric distance of 2 to 4 earth radii are deduced from whistler observations made, primarily, at Stanford, California, and Seattle, Washington. The whistler quantities scaled are frequency and group delay at the whistler nose and group delay at 5 kc. Depressions in electron density are found to be associated with severe magnetic storms ($K_p \geq 6$) in both 1958 and 1961. Typical depressions exhibit density levels about 15 to 20% below average levels. The annual variation, with a minimum near the June solstice, is observed in every year from 1958 to 1961. The ratio of June to January density levels is about 0.66 in 1958 and 0.81 in 1961. This variation is discussed as a possible indicator of a systematic variation in the physical environment of the earth along its orbit. The secular variation shows a 20 to 25% reduction in electron density from early 1958 to early 1961. There is some evidence that the larger part of the observed reduction occurs near the December solstice, when the annual variation shows a maximum. Secular and annual variations are found in the latitude of the field-line-path endpoint of typical Stanford whistlers. From 1958 to 1961 the average latitude moves slowly equatorward through about 1° while remaining several degrees on the poleward side of Stanford. The annual variation shows an equatorward movement from January to June through 4° or 5°. As a matter of methodology, it is found that a limited quantity of data on frequency and group delay at the whistler nose can be used to remove path ambiguities from more easily obtained single-frequency group-delay data (which include whistler-mode echoes from pulse transmissions). When this is done, important information can be obtained on whistler propagation, and the group-delay data can then be used directly in the study of magnetospheric density variations. (auth)

3937 THE MAGNETIC EFFECTS OF MAGNETOSPHERE SURFACE CURRENTS. David B. Beard and Edward B. Jenkins (Univ. of California, Davis). J. Geophys. Research, 67: 3361-7(Aug. 1962).

The electrical currents on the interface separating the geomagnetic field from the solar corona create a magnetic field everywhere interior to the interface. This surface current magnetic field has been computed in the meridian plane on the sunlit side of the earth by integration over the surface currents on the interface. It was found that apart from polar regions the surface current magnetic field increases linearly with altitude. At the subsolar point the increase is from 14 γ at the earth's surface to 35 γ at the edge of the magnetosphere during normal solar activity when the altitude of the magnetosphere is at 10 earth radii. If abnormal solar activity lowered the altitude of the interface to 5 earth radii, the magnetic field at the surface of the earth would increase by 135 γ. A sudden change in interface altitude of 2 earth radii would cause a sudden change in magnetic field at the earth's surface of about 16 γ. Such a change has been observed. (auth)

3938 RADIOACTIVE COBALT AND MANGANESE IN DISCOVERER 17 STAINLESS STEEL. John T. Wasson (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Research, 67: 3513-17(Aug. 1962).

Co^{57} was measured in the same stainless steel sample in which Fireman, DeFelice, and Tilles found large amounts of tritium. The amount of Co^{57} produced in the steel was a factor of 23 less than that expected from in situ production of the tritium by alpha-stripping processes. Upper limits on the activities of Co^{56}, Co^{60}, and Mn^{54} were established. Rough upper limits on the proton flux at the stainless-steel battery case are estimated from these values, and the results are compared with the proton flux necessary to produce Co^{57} by interactions with the Ni^{58} in the steel. (auth)

3939 THE MORPHOLOGY AND TEMPORAL VARIATIONS OF THE VAN ALLEN RADIATION BELT, OCTOBER 1959 TO DECEMBER 1960. S. E. Forbush, G. Piz-

zella, and D. Venkatesan (Iowa State Univ., Iowa City). J. Geophys. Research, 67: 3651-68(Sept. 1962).

The time variations of intensity in the 'horn' of the outer Van Allen radiation belt as measured by the omnidirectional GM counter 302 in Explorer 7 were investigated for the period October 1959 to December 1960. A consistent empirical relationship between intensity and scalar magnetic field B was derived for different values of the magnetic shell parameter L that made it possible to correct for dependency of intensity on B and thus to examine the true time variations at any fixed L. The correlation between counting rates in the outer zone over North America and Australia at the same value of L improved decidedly after correction for B. The changes in the corrected intensity for several L values between 2.5 and 4.7 earth radii revealed some large variations (greater than a factor of 100) prominent only between L = 2.5 and L = 3.2, and some fluctuations by a factor of 10 only at the larger L values. The temporal variations of intensity between L = 2.5 and 3.5 over North America are similar to those between L = 1.8 and 2.5 over South Africa. The changes in intensity tend to be correlated negatively with U, the geomagnetic equatorial ring current field, for L > 3.4, and positively for L < 3.4. L_{max}, the value of L at which the maximum intensity occurs, tends to decrease with increasing U, the correlation coefficient between L_{max} and log U being −0.7. During the main phase of large magnetic storms the intensity for L > 3.5 is generally less, and for L < 3.5 it often tends to be greater, than before the storms. For $2.5 \leq L \leq 3.5$ nearly all the observations over Australia, and about half those over North America, were at B values equal to or greater than those at sea level over the region of South Africa for the same L values. Consequently, all the particles observed under these conditions over Australia and North America are lost as they drift over the regions of South Africa. The observed intensities over Australia, in particular, measure the outflux of particles from the outer radiation belt in a time interval less than the longitudinal drift period. This result implies a very high rate of replenishment of energetic electrons in the outer belt. (auth)

3940 SEPTEMBER 26, 1960, SOLAR COSMIC-RAY EVENT. C. E. Fichtel, D. A. Kniffen, and K. W. Ogilvie (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Research, 67: 3669-72(Sept. 1962).

Type IV radio emission is thought to be the most important observable characteristic of solar flares producing high-energy particles. It is shown that solar cosmic-ray particles arrived at the earth on September 27, 1960, after a small flare accompanied by a type IV burst of short duration. Apart from the magnitude, the characteristics of this event do not differ essentially from those of larger events. (auth)

3941 OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959. 5. VISUAL AURORAS, HIGH-ALTITUDE X-RAY BURSTS, AND SIMULTANEOUS SATELLITE OBSERVATIONS. R. L. Arnoldy (Univ. of Minnesota, Minneapolis), R. A. Hoffman, J. R. Winckler, and S.-I. Akasofu. J. Geophys. Research, 67: 3673-86(Sept. 1962).

The measurements made in the outer trapped radiation region by the University of Minnesota ionization and Geiger counter and the scintillation counter aboard the Explorer 6 earth satellite during the August 16, 1959, magnetic storm are studied. The variations in the detector rates are correlated with the visual aurora recorded by all-sky cameras and with high-altitude x-ray bursts observed by balloon-borne detectors. An increase in radiation observed at a geocentric range of 42,000 km simultaneously with the occurrence of a visual aurora on the electron shell connecting with the satellite measurements suggests that the aurora is associated with a disturbance extending over many degrees of longitude and out to large ranges. Furthermore, a rapid decrease in the Geiger counter rate coincident with a strong low-latitude aurora at Fargo, North Dakota, indicates that energetic radiation is either precipitated out of the outer zone during strong auroras or decelerated by a perturbation of the earth's magnetic field accompanying the aurora. Frequent observations of rate variations at the outer edge of the trapped radiation and at apogee point out the great instability there that results in the frequent discharge of radiation into the atmosphere observed by balloon-borne detectors at the high latitudes connecting with the region. The close correlation of outer-zone intensity variations and solar phenomena indicates that the energy involved in the dynamics of the trapping region has a solar origin. (auth)

3942 LIFETIMES OF OUTER-ZONE ELECTRONS AND THEIR PRECIPITATION INTO THE ATMOSPHERE. B. J. O'Brien (Iowa State Univ., Iowa City). J. Geophys. Research, 67: 3687-3706(Sept. 1962).

The time-averaged intensity of electrons with energy (E) $\gtrsim$40 kev has been measured with Explorer 12 to be of the order of 10^7 particles $(cm^2\ sec)^{-1}$ between equatorial radial distances (L) of ~2 and ~10 earth radii. The outflux of these electrons has been measured with the satellite Injun 1 at 1000-km altitude over North America. The average intensity varied from $\sim 10^3$ particles $(cm^2\ sec)^{-1}$ at invariant latitude (Λ) ~45° to $\sim 10^5$ particles $(cm^2\ sec)^{-1}$ in the auroral zone and then fell off very rapidly at higher latitudes. Accordingly, if the source of the electrons was stopped, but the outflux continued at the same rate, the outer zone beyond $L \gtrsim 2$ would drain empty of electrons in a few hours. Requirements that the source of acceleration mechanism must satisfy are specified. The neutron-albedo source is of the order of 100 million times too weak to satisfy one of these requirements. The latitude profile of electron outflux is remarkably similar to the profile of the frequency of occurrence of auroras. It is suggested that the 'leaky bucket' model of the outer-zone electrons be replaced by a 'splash catcher' model, although this is undoubtedly an oversimplified model. The excitation of the 5577 A emission in night airglow by electrons as in weak auroras is discussed. The outflux of electrons with $E \geq 40$ kev is far too weak to excite all this emission, and it is shown that the outflux of electrons with $E \geq 1$ kev is probably too weak also. It is concluded, therefore, that the dominant part of 5577 A nightglow emission over North America is not phenomenologically the same as a weak and permanent aurora. This conclusion rests on the assumption that the electron energy spectrum between 1 and ~100 kev is essentially independent of pitch angle at 1000-km altitude; this assumption is discussed. (auth)

3943 A STATISTICAL ANALYSIS OF COSMIC-RAY INTENSITY CHANGES ASSOCIATED WITH SOLAR FLARES. B. G. Wilson and C. P. Nehra (Univ. of Alberta, Calgary, Can.). J. Geophys. Research, 67: 3707-16(Sept. 1962).

The Chree method has been used to analyze cosmic-ray data recorded by neutron monitors at Sulphur Mountain (geomagnetic latitude 58°N) and Resolute (geomagnetic latitude 83°N) during 1959 and 1960, in an attempt to determine changes in cosmic-ray intensity associated with solar flares. A total of 274 solar flares of magnitude ≥2

was considered. It has been found that small increases in the intensity of the nucleon component, of the order of 0.25 per cent, are recorded at Sulphur Mountain associated with the appearance of solar flares which are accompanied by shortwave fadeout. No appreciable changes occur otherwise. The Resolute data indicate a small increase for flares accompanied by shortwave fadeout during 1959 but no change for other flares; no significant changes in the intensity of cosmic radiation at Resolute followed the appearance of optical flares during 1960. (auth)

3944 A STUDY OF THE PRECIPITATION OF ENERGETIC ELECTRONS FROM THE GEOMAGNETIC FIELD DURING MAGNETIC STORMS. J. R. Winckler (Univ. of Minnesota, Minneapolis), P. D. Bhavsar, and K. A. Anderson. J. Geophys. Research, 67: 3717-36(Sept. 1962).

The x rays produced by electron precipitation from the geomagnetic field have been further studied by means of scintillation counters carried on balloons launched simultaneously at four sites between Waterloo, Iowa, and Flin Flon, Manitoba, Canada. The latitude and detailed time profile were measured during two magnetic storms on September 25, 1961, and October 1, 1961. The integrated photons per centimeter^2 for the two storms show very different latitude profiles. On September 25 the intensity increased to the highest latitude (64.5° geomagnetic). On October 1 the profile was highest at 55° and dropped off to a very low value at the high latitude. These differences seem connected with the fact that the September storm was of the recurrent type, and the October 1 storm was more violent and was induced by a large solar flare. The detailed comparison with the total energy stored in the magnetic field, obtained from recent measurements of the trapped radiation in the energy range comparable with the balloon measurements, shows that about one or two orders of magnitude more energy was precipitated than in normally stored quiescently, indicating that during the magnetic disturbance the addition of energy to the electrons in the magnetic field is necessary. A more extreme case, observed on July 16, 1961, at Fort Churchill and at Minneapolis, shows that during a strong magnetic sudden impulse more than two orders of magnitude more energy was precipitated than is quiescently trapped. The precipitation has been observed with the data averaged in time intervals between 120 sec and 0.1 sec. We find that during periods of intense precipitation a large fraction of the precipitation occurs in bursts of high intensity lasting only 0.1 sec. It is suggested that these rapid bursts can account for the flashes or pulsations observed in strong auroral storms. Power spectrum analysis methods have been applied to the counting rate data, and we find periodic precipitation occurring with periods of 0.8, 1.6, and 3.2 sec and higher multiples. It is suggested that this constitutes direct evidence for particle bunches near 60-kev energy oscillating between conjugate points in the geomagnetic field. A Chree analysis applied with the large impulsive bursts as zero epoch confirms this picture and shows that the same periods occur in fixed phase relationship to the bursts. (auth)

3945 THE INTERACTION BETWEEN THE SOLAR WIND AND THE EARTH'S MAGNETOSPHERE. W. I. Axford (Defence Research Board, Ottawa). J. Geophys. Research, 67: 3791-6(Sept. 1962).

It is argued that the interplanetary gas can usefully be treated as a continuum as far as the interaction between the solar wind and the terrestrial magnetosphere is concerned. On this basis, since the solar wind is highly supersonic near the earth, a collision-free bow shock wave should be a permanent feature of interplanetary space on the sunward side of the magnetosphere. Other features of the solar wind flow pattern and the shape of the magnetosphere are also considered, and it is suggested that certain ionospheric phenomena are the direct result of linkage to the exterior surface of the magnetosphere via geomagnetic lines of force. (auth)

3946 RESIDUAL IONIZATION IN THE POLAR LOWER IONOSPHERE. J. B. Gregory (Univ. of Canterbury, Christchurch, N. Z.). J. Geophys. Research, 67: 3829-41 (Sept. 1962).

Turbulent scattering of 2.3 Mc/s radio waves is found to persist throughout the polar night between altitudes of 80 and 100 km at a geomagnetic latitude of 79°S. Residual electron densities are estimated to increase from 5/cm^3 at 80 km to 1 or 2×10^2 between 90 and 100 km. Transport processes are unable to maintain these concentrations, though turbulent transport may assist. Present estimates of electron loss rates require ionization rates in excess of cosmic-ray production. An equivalent vertical flux of protons of $0.2 < E < 4$ Mev energy and density up to 170/cm^2 sec, or, alternatively, of electrons with 10 kev $< E <$ 100 kev and density about 70/cm^2 sec, is called for. Time variations associated with solar protons and Forbush decreases of cosmic radiation suggest that protons are responsible. (auth)

3947 EFFECTS OF THE FINITE GYRORADII OF GEOMAGNETICALLY TRAPPED PROTONS. A. M. Lenchek and S. F. Singer (Univ. of Maryland, College Park). J. Geophys. Research, 67: 4073-5(Sept. 1962).

It has been noted recently that the gyroradii of trapped protons may be comparable with or exceed atmospheric scale heights, thereby possibly invalidating the infinitesimal gyroradius approximation commonly made in theoretical analyses. An attempt is made to clarify the conditions under which the effect of the finite gyroradius can be neglected and to point out a related observable effect: an east-west asymmetry. (W.D.M.)

3948 SIMULTANEOUS ELECTRON PRECIPITATION IN THE NORTHERN AND SOUTHERN AURORAL ZONES. K. A. Anderson, C. D. Anger, R. R. Brown, and D. S. Evans (Univ. of California, Berkeley). J. Geophys. Research, 67: 4076-7(Sept. 1962).

During Feb. and March 1962, a series of simultaneous high-altitude balloon flights was carried out from College, Alaska, and Macquarie Island, Australia, for the purpose of comparing features of electron precipitation into the northern and southern auroral zones at approximately the same geomagnetic longitude. Identical instrumentation was carried on the flights. The x-ray event of March 5, 1962, is discussed in detail. (W.D.M.)

3949 THE MAGNETIC FIELD OF THE RADIATION BELTS. Syun-Ichi Akasofu (Univ. of Alaska, College) and Joseph C. Cain. J. Geophys. Research, 67: 4078-80(Sept. 1962).

The magnetic fields produced by various types of belts of trapped particles are shown graphically. The values of the parameters that determine the field were chosen to cover a wide range. By interpolating the diagrams the distortion of the earth's field can be approximately estimated for actually observed belts without a large amount of computation. (W.D.M.)

3950 RADIO EMISSION BY ELECTRONS IN THE FINE-STRUCTURE ELECTRIC FIELDS OF SHOCK WAVES. D. A. Tidman (Univ. of Maryland, College Park). Phys. Fluids, 5: 1104-12(Sept. 1962).

The structure of shock waves in fully ionized hydrogen in the absence of a magnetic field has been investigated by Greenberg and Trève using the Mott-Smith distribution for the protons and a local Maxwellian for the electrons. They find that large charge-separation effects occur inside the shock due to the electron-proton mass difference, thus giving rise to strong stationary electric-field oscillations in the shock transition. This behavior is typical of other theories of plasma shock structure. The radio noise emitted by electrons in the plasma accelerated in these electric fields is now calculated. In traversing the electric oscillations inside the shock, those electrons with a few times the thermal energy radiate like an assembly of oscillators at frequencies capable of propagating ahead of the shock. Although the particular shock-wave model of Greenberg and Trève has been adopted for the purposes of the numerical discussion, the parameters of the radiation calculation are readily adjusted for possible changes in the shock-wave model which more detailed treatments of shock structure may bring. The application of this process to Type II solar radio bursts is discussed. Assuming that such shock waves are produced by a solar flare expanding into the corona, a sufficiently high intensity of radio emission is found to provide an alternate possible interpretation for this source of solar noise. (auth)

3951 ARRIVAL TIMES OF AIR SHOWER PARTICLES AT LARGE DISTANCES FROM THE AXIS. John Linsley and Livio Scarsi (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 128: 2384-92(Dec. 1, 1962).

A study has been made of the relative times of arrival of shower particles at large distances (200 to 1500 m) from the shower axis. Data were obtained at the MIT Volcano Ranch Station, using an array of 20 scintillation detectors, one of which was shielded part of the time. The shower size, direction, and core location were determined for each event. The spatial distribution of shower particles at a given instant is described by means of three curved surfaces: the median surface for the penetrating particles (muons), the median surface for the electrons, and the extreme front. It is found that the average median surface for the muons is approximately spherical, the center being located at an atmospheric depth of 320 ± 70 g cm^{-2}, and that the average median surface for the electrons has a radius of curvature of about 1 km at a distance from the axis of 450 m. The electron radius of curvature increases at greater distances. Assuming that the extreme front is spherical, its average center must be located above 320 g cm^{-2}. The radius for curvature of the extreme front for a small number of individual showers was measured. (auth)

3952 COSMIC-RAY COMPOSITION AT $10^{17}-10^{18}$ ev. John Linsley and Livio Scarsi (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 9: 123-5(Aug. 1, 1962).

Evidence is presented, based on the proton-energy dependence of the proportion of mu particles produced in proton-induced showers, that cosmic primaries having total energies greater than about 10^{17} ev are nearly all protons. The ratio of the number of mu particles to the total number of particles is measured in air showers for which the primary energies are above 10^{17} ev, and the distributions indicate that these showers are produced by primary protons. (T.F.H.)

3953 REMARKS ON COSMIC-RAY COMPOSITION. John Linsley (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 9: 126(Aug. 1, 1962).

It is noted that evidence exists that cosmic primaries having total energies greater than about 10^{17} ev are nearly all protons. This evidence requires, in order to explain large air showers (greater than 10^{19} particles), that there exist a metagalactic component of cosmic radiation. (T.F.H.)

3954 THE DURHAM COSMIC RAY SPECTROGRAPH. I. THE GENERAL FEATURES OF THE INSTRUMENT. G. Brooke, M. Gardener, J. L. Lloyd, S. Kisdnasamy, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 80: 674-85(Sept. 1, 1962).

An account is given of the general features of a cosmic ray spectrograph with a maximum detectable momentum of 26.5 Bev/c. Particular attention is given to the determination of the correction factors needed for accurate measurements of particle momenta. The instrument has an acceptance rate of 5000 particles per day. (auth)

3955 THE DURHAM COSMIC RAY SPECTROGRAPH. II. THE ELECTRONIC AND AUTOMATIC RECORDING SYSTEMS. D. G. Jones, F. E. Taylor, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 80: 686-96(Sept. 1, 1962).

The design characteristics and performance of the electronic circuits used in the cosmic ray spectrograph are described. These circuits select single particles which have traversed the instrument and automatically record their deflections in the magnetic field. (auth)

3956 THE MOMENTUM SPECTRUM OF COSMIC RAY MUONS NEAR SEA LEVEL IN THE MOMENTUM RANGE 0.4 TO 10 Gev/c. M. Gardener, D. G. Jones, F. E. Taylor, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 80: 697-709(Sept. 1, 1962).

The momentum spectrum of muons in the vertical cosmic ray flux at Durham has been measured for the momentum range 0.4–10 Bev/c. The measurements are based on some 191,000 trajectories. The bias introduced by the condition that the particles should be unaccompanied has been studied and found to be small. The measurements on the momentum spectrum are compared with those of other workers and possible causes of the discrepancies are examined. It is concluded that the relative intensities are known with an accuracy to about 3% over the range 0.4–10 Bev/c. The production spectrum of cosmic ray pions has been determined under the assumption that the sea-level muons all come from pions. Representing the spectrum as $N(p_\pi) = Ap_\pi^{-\gamma}$, γ is found to be constant and equal to 2.65, for $p_\pi > 5$ Bev/c. Below this momentum γ falls continuously and reaches the value 1.93 at a pion momentum of 1 Bev/c. The production spectrum agrees well with those given by Olbert in 1954 and by Puppi in 1954 above 3 Bev/c but has significantly lower intensity at lower momenta. (auth)

3957 THE MOMENTUM SPECTRUM OF COSMIC RAY MUONS NEAR SEA LEVEL IN THE MOMENTUM RANGE 5 TO 1000 Gev/c. P. J. Hayman and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 80: 710-28(Sept. 1, 1962).

The momentum spectrum of cosmic ray muons in the vertical direction at Durham has been measured for the momentum range 5–1000 Bev/c. The high maximum detectable momentum has been made possible by the modification of the original spectrograph by the addition of neon flash-tube arrays at the measuring levels. The work described is based on 14,556 particles, 4,520 of which had momenta above 20 Bev/c. Comparison with other workers shows that the spectrum is in good agreement up to 100 Bev/c. (auth)

3958 RANGE STRAGGLING OF MUONS IN THE ENERGY RANGE 200 TO 100,000 Gev. P. J. Hayman, N. S.

Palmer, and A. W. Wolfendale (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 80: 800-2(Sept. 1, 1962).

The energy spectrum of cosmic muons at sea level can be used with the measured variation of cosmic ray intensity with depth underground to study the rate of energy loss of muons at high energies. A quantitative estimate is made of range straggling for muons penetrating rock. Monte Carlo calculations were performed with a computer and the behavior of 1000 muons was studied for each incident energy and for two assumed forms of the energy loss equation. (W.D.M.)

Criticality Studies

3959 (TID-17240) PRECISE CRITICALITY DETERMINATIONS IN THE SOLID HOMOGENEOUS ASSEMBLY. F. Feiner, S. Weinstein, W. C. Oaks, and K. V. Cooper (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 11p.

To accommodate large metal fractions, but still retain the advantages of homogeneity, the Solid Homogeneous Assembly (SHA) was designed with the metallic elements and fuel as very fine powders dispersed in paraffin. A series of reproducibility checks performed with the assembly demonstrated that rearranging or replacing major segments of the core leads to reactivity changes of 'ess than 10¢. In addition to critical size determinations p.eliminary flux distribution and reactivity coefficient measurements were made. The calculated criticalities using the KARE and KLAG programs were compared with the experimental ones. It was found that calculations run approximately 2% high fairly consistently. (M.C.G.)

3960 (UCRL-6673) A COOLED-REFLECTOR, HOT-BeO-CORE CRITICAL EXPERIMENT. R. G. Finke, E. Goldberg, H. L. Reynolds, and G. J. Grammens (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 27, 1961. Contract W-7405-eng-48. 29p.

A series of critical experiments to investigate temperature-reactivity effects and temperature-power distribution interactions with a cooled graphite reflector on two sides of a BeO core is described. It was found that for a core with a gross BeO/U^{235} ratio of 556 to 1, the reactivity was not dependent on the graphite reflector temperature. The experiments were performed at the HOT BOX facility. (J.R.D.)

3961 (WCAP-1373) REVISION OF THE STORAGE OF NUCLEAR FUEL AT THE WESTINGHOUSE REACTOR EVALUATION CENTER. R. J. French (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Dec. 31, 1959. Contract [AT(30-3)-222]. 14p.

A description of the revised storage method for nuclear fuel is given. The fuel material for which the storage facility is designed is described and an analysis of the criticality condition is performed. The conclusion is drawn that the storage procedure is safe. (auth)

Elementary Particles and Radiations

3962 (AFOSR-2390) EFFECT OF A PERIODIC POTENTIAL ON A DEGENERATE FERMI GAS. Technical Note No. 14. S. Moszkowski and L. Wilets (Weizmann Inst. of Science, Rehovoth, Israel). Jan. 18, 1962. Contract AF61(052)-337. 24p. (AD-273697)

The effect of a periodic potential on the particle and energy density of a degenerate Fermi gas is considered. It was found that for a weak and long wavelength potential the inhomogeneity correction (deviation from the Thomas Fermi statistical model) to the kinetic energy density is only 1/9 as large as the Weizsacker estimate. The potential energy density due to Majorana exchange two-body interactions of short range is also given to a high accuracy by the statistical model; the corrections are only 1/9 as large as for a short range Wigner (ordinary) interaction. For the analogous two dimensional Fermi gas, the inhomogeneity corrections vanish at least to high order unless the periodic potential contains short wavelength components. Relevance to the problem of the nuclear surface is discussed. (auth)

3963 (IA-773) NEW LEPTON GROUP. Y. Ne'eman (Israel. Atomic Energy Commission, Rehovoth). Sept. 1962. 11p.

A symmetry scheme is proposed for the leptons, with (μ^+, ν, e^-) as the fundamental vector in accordance with the original Konopinsky-Mahmoud assignments. A representation of R(3) infinitesimal operators generates the weak currents, reproducing the observed chiralities. The full symmetry requires an additional neutral component. (auth)

3964 (JINR-P-1040) IZUCHENIE POLARIZATSII λ GIPERONOV PRI ROZHDENII V n^--p VZAIMODEISTVIYAKH S ENERGIEI 7-8 Bev. (Studies of Polarization of λ Hyperons Produced in π^--p Interactions as 7 to 8 Bev). V. I. Veksler, N. M. Viryasov, I. Vrana, Hui-ying Kim, E. N. Kladnitskaya, A. A. Kuznetsov, Ding-tu Nguien, M. I. Solov'ev, T. Khofmokl, and Ling-yang Ch'en (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 24p.

Polarization of λ hyperons in π^--p interactions at π^- energies of 7 to 8 Bev was studied, and the derived magnitudes, $a\overline{P}_1$ (forward and backward) = +0.04 ± 0.08, $a\overline{P}_2$ (up and down) = +0.01 ± 0.08, and $a\overline{P}_3$ (right-left) = −0.06 ± 0.08, showed that λ hyperons are originally not polarized. The angular distribution of λ generation planes is constructed in relation to the K^0 generation plane when λ-K^0 pairs are recorded and in relation to the plane of $\pi^-(\pi^+)$ generation in two-prong stars. The obtained results are in good agreement with parity conservation in strong interactions. (tr-auth)

3965 (NP-12262) ON MANDELSTAM'S PROGRAM IN POTENTIAL SCATTERING. H. M. Nussenzveig (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1962. 56p. (Notas de Física Vol. IX, No. 16(p.269-323)).

Mandelstam's program for constructing the scattering amplitude from its analytic properties and unitarity was analyzed in the case of nonrelativistic scattering by a cut-off potential or by a hard sphere. The asymptotic behavior of the scattering amplitude in the momentum transfer plane was obtained, leading to a double dispersion representation for the amplitude. The usefulness of this representation is limited by an essential singularity at infinity in the momentum transfer plane. An infinite system of dispersion relations, connecting each partial wave with all succeeding ones, was derived from the dispersion relation for fixed momentum transfer. The partial-wave amplitudes must be constructed from this system together with the unitarity conditions. Possible ambiguities in the solution of this problem were investigated. It is shown that ambiguities in the exact solution affecting only a finite number of partial waves (Castillejo, Dalitz and Dyson ambiguities) do not exist. They would arise, however, in approximate solutions and it would be very hard, in practice, to eliminate them from the exact solution. The ambiguities can be formulated in terms of the positions of the poles of the S-matrix. A series of sum rules which

must be fulfilled by the poles is derived. The solution of the system was investigated in the particular case of scattering by a hard sphere. In this case, if one assumes that the exact solution is known for angular momenta larger than some (arbitrarily given) value, each partial-wave dispersion relation for smaller values of the angular momentum can be exactly solved, and it follows from the sum rules that the solution is unique. (auth)

3966 (NP-12263) BARGMANN-WIGNER THEORY FOR PARTICLES OF SPIN 3/2. Colber G. Oliveira and Alberto Vidal (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1962. 7p. (Notas de Física Vol. IX, No. 13(p.225-31))

A development of the formalism of Bargmann and Wigner for the case of a free spin-$^3/_2$-particle is presented. A comparison with the Rarita-Schwinger theory is discussed. It is shown that the theories are equivalent. (auth)

3967 (TID-17251) SPIN $^1/_2$ WAVE EQUATION IN DE-SITTER SPACE. F. Guersey (Middle East Technical Univ., Ankara) and T. D. Lee (Columbia Univ., New York). [nd]. Contract [AT(30-1)-Gen-72]. 18p.

Starting from an invariant Lagrangian, the wave equation of a spin-$^1/_2$ particle in the de-Sitter space was derived. Relation between this equation and an earlier form obtained by Dirac is discussed. (auth)

3968 (UCRL-9792) ON CHARGE CONJUGATION. K. M. Case (California. Univ., Berkeley. Lawrence Radiation Lab.). July 19, 1961. Contract W-7405-eng-48. 8p.

It is shown that under very general assumptions the existence of an antiunitary reflection transformation and the charge gauge group implies the existence of an antiparticle corresponding to a given charged particle. Similar consequences follow on replacing the charge gauge group by the baryon gauge group. No assumptions as to specific wave equations, or indeed the existence of local fields, are made. (auth)

3969 (UCRL-10378) DIFFERENTIAL CROSS SECTIONS FOR ELASTIC SCATTERING OF POSITIVE PI MESONS ON PROTONS IN THE ENERGY REGION 500 TO 1600 Mev (Thesis). Jerome A. Helland (California. Univ. Berkeley. Lawrence Radiation Lab.). Aug. 15, 1962. Contract W-7405-eng-48. 91p.

Differential cross sections for the elastic scattering of positive pi mesons on protons were measured at the Berkeley Bevatron at laboratory kinetic energies of the pion between 500 and 1600 Mev. Fifty scintillation counters and a matrix coincidence system were used to detect the recoil proton and the pion, both before the latter reached a liquid-hydrogen target and after scattering. Various corrections were applied to the data, and the results were fitted with a power series in the cosine of the scattering angle in the center-of-mass system. Total elastic cross sections were obtained by integrating under the fitted curves. The coefficients of the cosine series are shown plotted vs the laboratory kinetic energy of the pion. The most striking features of these curves are the large positive value of the coefficient of $\cos^6 \theta^*$, and the large negative value of the coefficient of $\cos^4 \theta^*$, both of which peaked in the vicinity of the 1350-Mev peak in the total cross section. These results indicate that the most predominant state contributing to the scattering at the 1350-Mev peak has total angular momentum $J = {}^7/_2$, considering that the coefficients for terms above $\cos^5 \theta^*$ are negligible at this energy. One possible explanation is that the 1350-Mev peak is the result of an F_{γ} resonance lying on the same Regge-pole trajectory as the famous (3,3) resonance near 195 Mev. (auth)

3970 RELATIVISTIC QUANTUM THEORY AS A GROUP PROBLEM. III. THE INTERACTION FORMALISM. Y. Ahmavaara. Ann. Acad. Sci. Fennicae, Ser. A VI, No. 106, 5-42(1962). (In English)

The interaction formalism of relativistic quantum theory is given a group-theoretical exposition. A postulate is formulated, imposing conditions on the representations of the basic group G, and allowing the determination of the S-matrix by the group representations. The determination of the S-matrix is not complete in general. Cases of complete undetermination and of partial determination occur for a continuous group G of world geometry. The case of complete determination is possible in a finite world geometry. Accordingly, in a continuous world geometry, additional hypotheses (like a dynamical principle, local commutativity, etc.) are necessary for a unique determination of the interactions of quantum particles, while a pure group-theoretical treatment of interactions, without any dynamical or local elements, might possibly be realized in a finite world geometry. (auth)

3971 ANNIHILATION OF 1.3 Bev ANTIPROTONS IN COMPLEX NUCLEI. B. E. Ronne, P. J. Carlson, and O. Danielsson (Univ. of Stockholm). Arkiv Fysik, 22: 193-217(1962). (In English)

An investigation of 537 interaction stars in nuclear emulsions, of which some 215 are caused by 2-Bev/c antiprotons and the rest to negative pions, is reported. The antiproton mean free path of annihilation is found to be 26 ± 5 cm. Experimental results concerning antiproton stars are obtained from measurements on the sample of stars by subtracting the known pion contribution from the measured quantities. The average number of charged pions outside the nucleus for antiproton stars is 2.64 and the average total energy per pion 430 ± 50 Mev. The mean number of emitted protons is 7.55 ± 0.70 and the mean energy per star that these carry away is 415 ± 50 Mev. The average pion multiplicity in the annihilation process is found to be 5.0. The calculation of this value requires a study of secondary interactions of primary pions in the nucleus where the annihilation occurs. It is found that 30 per cent of the primary pions leave the nucleus without interacting, 28 per cent are absorbed, 30 per cent leave the nucleus after one or more elastic and/or charge-exchange scatterings, and 12 per cent give rise to production of new pions through inelastic scattering. No antisigma hyperons are found. (auth)

3972 DEGENERACY WITH RESPECT TO ISOTOPIC SPIN AND HYPERCHARGE. A. M. Baldin and A. A. Komar. Dokl. Akad. Nauk SSSR, 146: 574-6(Sept. 21, 1962). (In Russian)

After examining known experimental data concerning resonances in pion and pion-hyperon systems it was concluded that for most multiplets with T = 1 there is a singlet with T = 0 which has the same quantum numbers and approximately the same mass. A table was drawn up summarizing the accumulated data. From symmetry considerations it was observed that a π_0^0 meson, the singlet corresponding to the known triplet of ordinary pions, is obviously missing. It is suggested that perhaps its interaction with nucleons is very weak due to the fact that nucleons have a hypercharge and therefore their interactions with the singlet meson may be completely different than with the other pions. It is also suggested that more complete understanding of hypercharge could be achieved by examining the four-dimensional group rotations in isospace. The existence of degeneracy of isospin demonstrates the important role which the four-dimensional group plays in the investigation of strong interactions. (TTT)

3973 INELASTIC pn-INTERACTIONS AT AN ENERGY OF 9 Bev. V. A. Botvin, Zh. S. Takibaev, and P. A. Usik (Inst. of Nuclear Physics, Kazakhstan Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 146: 785-8 (Oct. 1, 1962). (In Russian)

Protons from a synchrophasotron were allowed to hit an emulsion pile, and 236 cases of inelastic p-n reactions were selected for analysis. The angular distribution of secondary protons in the center-of-mass system was asymmetric with a majority of the protons being present in the backwards direction. The asymmetry was determined by the following ratio: $\eta = (N_+ - N_-)/(N_+ + N_-)$. Here N_+ is the number of particles emitted in the forward direction, N_- is the number of particles emitted in the backwards direction, and $N_+ + N_- = N$. The value of η was found to be -0.33 ± 0.15, and was independent of the number of secondary particles in the star. The experimental results can be explained theoretically on the basis of a single-meson process of interaction with "excitation" of one of the interacting nucleons. (TTT)

3974 COLLISION INTEGRAL FOR CHARGED PARTICLES WITH COULOMB INTERACTIONS. V. P. Silin. Fiz. Metal. i Metalloved., 13: 180-91(1962). (In Russian)

Charged particle collision integrals, considering polarization effects, were found. Cases of slowly varying and fast changing processes are analyzed. (tr-auth)

3975 EXPERIMENTS ON THE EXISTENCE OF DINEUTRONS. Akira Katase, Masao Seki, Tsunekazu Akiyoshi, Atsushi Yoshimura, and Masateru Sonoda (Kyushu Univ., Fukuoka). J. Phys. Soc. Japan, 17: 1211-12(July 1962). (In English)

Dineutrons supposedly emitted in the D + T reaction were searched for at the deuteron energy of about 200 kev by detecting (1) the 2.16 min alpha activity of Bi^{211} from $Bi^{209}(n^2,\gamma)Bi^{211}$ and (2) the 1.28 Mev gamma from 6.56 min Al^{29} nuclei produced in the reaction $Al^{27}(n^2,\gamma)Al^{29}$. From the experiment no positive evidence of the existence of dineutrons was obtained. (W.D.M.)

3976 EXPERIMENTAL STUDY ON THE PENETRATION OF ^{60}Co γ RAY THROUGH FINITE HETEROGENEOUS MEDIA. [PART] II. Hiroji Mochizuki, Yoshihisa Tanaka, Yoshiharu Higashihara, and Kohtaro Nagato (Kawasaki Dockyard Co., Ltd., Japan). Nippon Genshiryoku Gakkaishi, 4: 703-7(Oct. 1962). (In Japanese)

The buildup factors obtained for a finite water medium previously were examined because of their discrepancy with the theoretical factors. The experiments confirmed the previously reported values. With relatively thick lead layers, buildup factors were also obtained for heterogeneous iron-lead media and compared with the theoretical values calculated from the generalized Kalos formula or the empirical formula introduced previously. The buildup factors for iron-lead multi-layers agree well with the theoretical factors, but not for lead-iron multi-layers in the case of thick layers of lead. The effect of the heterogeneity of compounds on buildup factors was also investigated. (auth)

3977 CALCULATION OF THE SPECTRUM OF μ CONTAMINATION IN A GROUP OF π MESONS. J. Fronteau (College de France, Paris). Nuclear Instr. & Methods, 16: 233-9(July 1962). (In French)

A general method of calculating the muon contamination of beams of charged pions produced by accelerators is presented. To obtain detailed numerical results the use of electronic computation is indicated and a computer program for this purpose is proposed. A variant of the method permits the calculation of neutrino fluxes through a given aperture. (auth)

3978 EXPERIMENTAL HYPERFRAGMENT BINDING ENERGIES. W. G. G. James (Chelsea Coll. of Science and Tech., London). Nuovo cimento (10), 23: Suppl., No. 2, 285-308(1962). (In English)

Since 1958 there has been approximately a five-fold increase in the number of uniquely identified hyperfragment binding-energy results. The new and old data are reviewed in terms of the analysis of hyperfragment events, experimental binding energies, and charge determination methods. (W.D.M.)

3979 CHARACTERISTIC MODIFIED X-RAY SCATTERING. K. Das Gupta (California Inst. of Tech., Pasadena). Phys. Rev., 128: 2181-8(Dec. 1, 1962).

The spectroscopic analysis of the scattered x rays from lithium, lithium oxide, lithium fluoride, beryllium, and boron irradiated by copper target radiation establishes the existence of sharp characteristic modified lines on the longer wavelength side of the primary beam. This is a new type of incoherent x-ray scattering. The K term values of lithium, beryllium, and boron and the L_1 term value of fluorine in lithium fluoride have been calculated from the observed modified lines and these are 58.1, 113.6, 199.0, and 40.6 ev, respectively. Taking into account the limits of error in these experiments, the term values obtained by this new method agree well with the values obtained by Skinner by the method of soft x-ray spectroscopy. Evidence obtained until now about the angular dependence of intensity of the newly observed modified lines brings up several interesting points helping to understand the particular process of scattering, and these points have been discussed. (auth)

3980 MAGNETIC QUENCHING OF POSITRONIUM IN SOLIDS AND POSITRON HELICITY. A. Bisi, A. Fiorentini, E. Gatti, and L. Zappa (Istituto di Fisica del Politecnico, Milan). Phys. Rev., 128: 2195-9(Dec. 1, 1962).

The magnetic quenching of the positronium decay was investigated in Teflon and Lucite as a function of the magnetic field up to 18 600 G by differentiating the triplet from the singlet state on the basis of annihilation time spectra. The experimental results strictly agree with the theoretical provisions. Using the theoretical value of the ground-state splitting the results led to the mean life of the positron in singlet positronium with its own electron equal to $(1.23 \pm 0.08) \times 10^{-10}$ sec and to $(1.21 \pm 0.11) \times 10^{-10}$ sec, respectively, for Teflon and Lucite. The polarization of the positrons just prior to capture was deduced by measuring the asymmetry in the counting rate due to the different positron's relative spin population of the ground-state positronium in a magnetic field. $P = +(0.75 \pm 0.11)\ (\bar{v}/c)$ and $+(0.73 \pm 0.13)\ (\bar{v}/c)$, respectively, in Teflon and Lucite, where $(\bar{v}/c)$ is the mean value of the positron longitudinal polarization over the β spectrum. (auth)

3981 THEORY OF THE DEEP PENETRATION OF ELECTRONS AND CHARGED PARTICLES. L. V. Spencer and J. Coyne (National Bureau of Standards, Washington, D. C.). Phys. Rev., 128: 2230-7(Dec. 1, 1962).

Charged particle penetration is amenable to elementary analysis if the continuous-slowing-down, small-angle, and diffusion-in-angle approximations are made. Such calculations are carried out in this paper, partly for their own interest and partly to demonstrate procedures of use in more realistic calculations. The calculations can be considered an extension of Yang's work to problems including energy loss. One section of the paper goes beyond the approximation of diffusion in angle to derive results for a scattering function with a large-angle tail. (auth)

3982 ENERGY DISTRIBUTION IN LOW-ENERGY ELECTRON-PHOTON SHOWERS IN LEAD ABSORBERS.

D. F. Crawford and H. Messel (Univ. of Sydney). Phys. Rev., 128: 2352-60(Dec. 1, 1962).

Detailed results for the energy distribution in electron-photon showers developing in lead absorbers are presented for the cases of primary electrons and photons of energy 50, 100, 200, 500, and 1000 Mev. These results show that Wilson's calculations on the same subject gave too low an energy degradation for electrons, thus making his electron numbers far too high. The total track length of electrons of energy >10 Mev for either electron or photon primaries is given by $T = 0.032E_0$ radiation lengths with E_0 in Mev. It is also found that: (a) The average energy of the individual electrons lost because their energy is <10 Mev is 6.98 Mev; (b) the average energy of photons with E < 10 Mev is 0.909 Mev; (c) the average energy of backscattered electrons with E > 10 Mev is 14.0 Mev; (d) the average energy of backscattered photons with E > 10 Mev is 13.1 Mev; (e) the average number of all photons produced per electron track length is 11.04. (auth)

3983 π-MESON PRODUCTION IN 2.9-Bev p-p COLLISIONS. A. C. Melissinos (Univ. of Rochester, N. Y.), T. Yamanouchi, G. G. Fazio, S. J. Lindenbaum, and L. C. L. Yuan. Phys. Rev., 128: 2273-81(Dec. 1, 1962).

Detailed measurements of the production of charged π mesons in proton-proton collisions are reported. The observed results are compared with the "isobar" and "one-pion exchange" models and for single production are in agreement if only the "resonant" part of the π-p cross section is used and if the angular distribution $\cos^{16}\theta$ is introduced for the production of the $N_{\frac{3}{2}}^{*}$ isobar. The effects of higher resonances are also considered. (auth)

3984 PHOTOPRODUCTION OF PION PAIRS NEAR THRESHOLD. P. Carruthers (Cornell Univ., Ithaca, N. Y.) and How-sen Wong. Phys. Rev., 128: 2382-4(Dec. 1, 1962).

The principal features of the reaction $\gamma + p \rightarrow p + \pi^+ + \pi^-$ in the proton lab energy range 300 to 800 Mev are shown to be accounted for quantitatively by the interaction current. The dominant process is the production of the 3-3 isobar along with an S-wave pion. (auth)

3985 STUDY OF THE K^+ DECAY. A. M. Boyarshi (Massachusetts Inst. of Tech., Cambridge), E. C. Loh, L. Q. Niemela, D. M. Ritson, R. Weinstein, and S. Ozaki. Phys. Rev., 128: 2398-2402(Dec. 1, 1962). (TID-14840)

Some properties of the various decay modes of K^+ mesons have been studied with hodoscope scintillation counters. 122 $K_{\mu 3}$ events were identified in the high-energy end of the muon energy spectrum from 115 ± 3 Mev to 134 Mev which yielded (0.42 ± 0.10)% as the relative branching ratio. The result, together with the K_{e3} branching ratio and the low-energy end of the $K_{\mu 3}$ muon energy spectrum, is found to satisfy a constant form factor V-A interaction. The muon longitudinal polarization for the $K_{\mu 3}$ events was found to be $+0.8^{+0.2}_{-0.3}$ which is two standard deviations from the calculated value −0.81 using the constant form factors which best fit the spectrum. A lifetime analysis of the decay modes gave $T(K_{\mu 3}) = (1.06 \pm 0.16) \times 10^{-8}$ sec, $T(K_{\pi 2}) = (1.197 \pm 0.032) \times 10^{-8}$ sec, and $T(K_{\mu 2}) = (1.259 \pm 0.018) \times 10^{-8}$ sec which are consistent with a single total lifetime, as expected. The total lifetime was found to be $T(K^+) = (1.23 \pm 0.011) \times 10^{-8}$ sec in agreement with previous values. The relative $K_{\mu 2}/K_{\pi 2}$ branching ratio was measured as 2.98 ± 0.25. A search for the occurrence of an intermediate-mass lepton in the decay $K \rightarrow \chi + \nu$ established 3×10^{-4} as the upper limit for the branching ratio with $m_e < m_\chi < 75$ Mev. (auth)

3986 INTERACTION OF PHOTONS AND GRAVITONS. J. Weber and G. Hinds (Univ. of Maryland, College Park). Phys. Rev., 128: 2414-21(Dec. 1, 1962).

The Hamiltonian formulation of general relativity is employed to study the interaction of photons and gravitons in the first approximation. The redundant variables are eliminated by an appropriate choice of gauge and coordinate conditions. S-matrix elements are calculated for initial states in which one photon is present and final states in which a photon and a graviton are present. Self-energy effects appear in first order but contribute nothing. Energy and momentum can be strictly conserved only if the initial and final photons and the gravitons all propagate in the same direction. For this case the S-matrix elements vanish in consequence of the null character of the Maxwell field, and the transition probability is also zero. Energy need not be exactly conserved if the process occurs at a rate which is sufficiently high. Under these conditions, corresponding to energies $\gg 10^{28}$ ev, a photon might decay into another photon and a graviton. The graviton has very low energy. This cannot explain the red shift as a "tired light" phenomenon. The creation of gravitons by Coulomb scattering of photons and by scattering in a magnetostatic field is shown to occur and the cross sections are calculated. (auth)

3987 MOTION OF ELECTRON WITH RADIATION DAMPING AND BOUNDARY CONDITIONS. A. A. Sokolov and B. A. Lysov (Moscow State Univ.). Phys. Rev., 128: 2422-24(Dec. 1, 1962).

The classical equation of motion of an electron with radiation damping is investigated. It is shown that a physically reasonable solution satisfying the given initial conditions can be obtained (i.e., the Cauchy problem formulated) only in the absence of radiation damping. On the other hand, once the radiation damping is taken into account, a boundary value problem arises and initial and final conditions must be prescribed. In conclusion, a comparison of these results and those of Schwartz is given. (auth)

3988 GAUGE INVARIANCE AND MASS. [PART] II. Julian Schwinger (Harvard Univ., Cambridge, Mass.). Phys. Rev., 128: 2425-9(Dec. 1, 1962).

The possibility that a vector gauge field can imply a non-zero mass particle is illustrated by the exact solution of a one-dimensional model. (auth)

3989 SCATTERING OF ELECTROMAGNETIC WAVES IN SAXON-SCHIFF THEORY. H. Ueberall (Conductron Corp., Ann Arbor, Mich.). Phys. Rev., 128: 2429-34 (Dec. 1, 1962).

The diffraction of electromagnetic waves by weak scatters with complex dielectric constant and permeability using the Saxon-Schiff theory of potential scattering is calculated. Boundary conditions, polarizations, and the optical theorem are discussed to some extent. The results for the scattering amplitude contain certain special cases obtained previously by other authors. In an Appendix, the results for the scattering by a homogeneous dielectric sphere are compared with those of the exact Mie theory. It is seen that the Saxon-Schiff theory gives a good qualitative agreement insofar as it reproduces the diffraction maxima and minima, in vast superiority to the Born approximation. In the asymptotic limit $kR \rightarrow \infty$, the radar cross section is shown to agree with the exact result for a not too large index of refraction. (auth)

3990 $\Sigma^0 - \Lambda^0$ RELATIVE PARITY FROM $\Lambda^0 \rightarrow \Sigma^0$ CONVERSION INDUCED BY THE COULOMB FIELD OF A NUCLEUS. Eduardo de Rafael (Physique Theorique et Hautes Energies, Orsay, France). Phys. Rev., 128: 2435-9(Dec. 1, 1962).

Dreitlein and Primakoff have recently proposed the use of the $\Lambda^0 \rightarrow \Sigma^0$ conversion induced by the Coulomb field of nuclei to determine the Σ^0 lifetime. It is shown that the

same experiment could also be used to measure the $\Sigma^0-\Lambda^0$ relative parity. Indeed, as a good approximation, the transversal polarizations (in the laboratory system) of the Λ^0 and Σ^0 particles are equal or opposite according as the $\Sigma^0-\Lambda^0$ relative parity is even or odd, respectively. (auth)

3991 REGGE POLES IN HIGH-ENERGY ELECTRON SCATTERING. R. Blenkenbecler, L. F. Cook, Jr., and M. L. Goldberger (Princeton Univ., N. J.). Phys. Rev., 128: 2440-54(Dec. 1, 1962).

The possibility that the photon is described by a Regge trajectory is considered, and the effect of this assumption on the analysis of electron-pion, electron-nucleon, and electron-helium scattering is examined in some detail. Partial-wave projections for the various amplitudes are made in the annihilation channel, and a multiparticle unitarity condition is formally imposed by use of the N/D matrix formulation. Since the photon does not have a fixed spin of one, the spin matrix structure is considerably more complicated than in the conventional theory. The amplitudes are written in terms of the Regge poles corresponding to the photon, ρ-ω meson, etc., and the resulting cross sections are given in the interesting high-energy limit. In contrast to the usual analysis, where form factors depend only on the momentum transfer, a larger number of independent functions is found which depend on the energy as well, however, in a characteristic manner. That is, the essential change due to the Regge behavior of the photon is an overall nonintegral power of the energy occurring in the cross section. The effect of this factor can be experimentally tested and this possibility is discussed. (auth)

3992 SPONTANEOUS BREAKDOWN OF ELEMENTARY PARTICLE SYMMETRIES. M. Baker and S. L. Glashow (Stanford Univ., Calif.). Phys. Rev., 128: 2462-71 (Dec. 1, 1962).

Following Nambu, Jona-Lasinio, and Goldstone, nonperturbative solutions of quantum field theory are sought. A model is first considered which possesses the higher symmetry SU(3). It is found that without the introduction into the Lagrangian of any symmetry-breaking terms, solutions exist which have only the lower symmetries of isotopic spin and hyperchange. It is also shown that the usual electrodynamic interaction of the muons and the electrons allows the possibility of generating a mass splitting between them. Finally a Lagrangian is considered in which the bare coupling constants are set equal to zero, and self-generated renormalized coupling constants are found. (auth)

3993 POLARIZATION IN PROTON-He^4 SCATTERING AT 38 Mev. C. F. Hwang, D. H. Nordby, S. Suwa, and J. H. Williams (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 9: 104-6(Aug. 1, 1962).

The angular distribution of the polarization of protons scattered by He^4 is measured. The incident proton beam has a polarization of 38% and mean energy of 38.4 Mev. The results are compared with the predictions of Gammel-Thaler phase shifts for 40-Mev elastic scattering of protons from He^4, and are found to disagree for center-of-mass angles over 80°. (T.F.H.)

3994 HIGH-ENERGY PROTON-PROTON DIFFRACTION SCATTERING. A. N. Diddens, E. Lillethun, G. Manning, A. E. Taylor, T. G. Walker, and A. M. Wetherell (CERN, Geneva). Phys. Rev. Letters, 9: 108-11(Aug. 1, 1962).

Momentum spectra of protons elastically scattered from protons through angles of about 10 to 50 mrad are measured at incident proton momenta of 12 to 27 Bev/c. The differential and total elastic cross sections are calculated. The results are analyzed in terms of the optical theorem for diffraction scattering. (T.F.H.)

3995 HIGH-ENERGY PROTON-PROTON SCATTERING. A. N. Diddens, E. Lillethun, G. Manning, A. E. Taylor, T. G. Walker, and A. M. Wetherell (CERN, Geneva). Phys. Rev. Letters, 9: 111-14(Aug. 1, 1962).

The proton-proton elastic scattering cross sections are measured at scattering angles of 55 to 110 mrad and at squared four-momentum transfers of 0 to 5.5 $(Bev/c)^2$. Incident momenta of 12 to 23 Bev/c are used. The data are analyzed in terms of a single-Regge-pole theory. (T.F.H.)

3996 RESONANCE IN THE ($\Xi\pi$) SYSTEM AT 1.53 Gev. G. M. Pjerrou, D. J. Prowse, P. Schlein, W. E. Slater, D. H. Stork, and H. K. Ticho (Univ. of California, Los Angeles). Phys. Rev. Letters, 9: 114-17(Aug. 1, 1962).

K^- meson interactions on protons at 1.80 Bev/c, in which a Ξ^- hyperon, a K meson, and possibly a π^0 or π^+ meson are produced, are studied in a bubble chamber. The distributions from about 250 events are found to be consistent with the existence of a Ξ^--π system at a resonant energy of 1.53 Bev, with a probable spin of $\frac{1}{2}$ and a possibility of spin $\frac{3}{2}$. (T.F.H.)

3997 THEOREM ON LOCAL ACTION OF LEPTON CURRENTS. A. Pais (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 9: 117-19(Aug. 1, 1962).

A theorem is derived concerning the effects and validity of local action of lepton currents in leptonic decays and in elastic and inelastic scattering of neutrinos. The theorem takes into account the lepton mass. The theorem is also applied to the reactions $\nu + p(n) \rightarrow n(p) + l$. (T.F.H.)

3998 $3\pi^0$ TO $\pi^+\pi^-\pi^0$ BRANCHING RATIO OF A $0^{-+}\eta$ MESON. K. C. Wali (Johns Hopkins Univ., Baltimore). Phys. Rev. Letters, 9: 120-3(Aug. 1, 1962).

Evidence in favor of the 0^{-+} assignment for the η meson is considered, based on a comparison of the 3π decay modes of the η meson with those of the K^+ and K_2^0 mesons. It is shown that the $3\pi^0/\pi^+\pi^-\pi^0$ branching ratio for the η meson is uniquely related to the π^0 energy spectrum in the decay $\eta \rightarrow \pi^+\pi^-\pi^0$. (T.F.H.)

3999 EVIDENCE FOR SPIN ZERO OF THE η FROM THE TWO GAMMA-RAY DECAY MODE. M. Chrétien (Brandeis Univ., Waltham, Mass.) and others. Phys. Rev. Letters, 9: 127-30(Aug. 1, 1962).

A study is made of the reaction $\pi + p \rightarrow \eta^0 + n$, followed by $\eta^0 \rightarrow 2\gamma$, at an incident π^- momentum of 1100 Mev/c. Analysis of the angle between the two photons indicates that the η^0 has a spin of 0 or 2, and symmetry properties of the Dalitz plots for this interaction indicates that the most probable spin for the η^0 is 0. The η^0 mass is calculated as 545 ± 30 Mev. (T.F.H.)

4000 PHOTOPRODUCTION OF K^+ MESONS IN HYDROGEN. R. L. Anderson, E. Gabathuler, D. Jones, B. D. McDaniel, and A. J. Sadoff (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters, 9: 131-3(Aug. 1, 1962).

Cross sections for the reactions $\gamma + p \rightarrow K^+ + \Lambda^0$ and $\gamma + p \rightarrow K^+ + \Sigma^0$ are measured at 934 to 1158 Mev photon energies. The angular and momentum distributions of the K^+ mesons are also measured. The reactions have thresholds of 911 and 1046 Mev, respectively. (T.F.H.)

4001 ω-MESON PRODUCTION IN PROTON-PROTON INTERACTIONS AT 2.85 BeV. E. L. Hart, R. I. Louttit, and T. W. Morris (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 9: 133-5(Aug. 1, 1962).

Double and triple meson (π) production (821 and 512 events respectively) in proton-proton interactions at 2.85

Bev is observed. The production of mesons (ω) in the reaction $p + p \rightarrow p + p + \pi^+ + \pi^- + \pi^0$ is indicated by a deviation of the distribution of the 3π effective mass from phase space. No η meson production is observed. (T.F.H.)

4002 K^+-p INTERACTION FROM 140 TO 642 Mev/c. Sulamith Goldhaber, William Chinowsky, Gerson Boldhaber, Wonyong Lee, Thomas O'Halloran, and Theodore F. Stubbs (Univ. of California, Berkeley). Phys. Rev. Letters, 9: 135-8(Aug. 1, 1962).

The cross section for the K^+-proton interaction at 140 to 642 Mev/c is found to depend only slightly on energy. The momentum dependence of the scattering phase shifts below 300 Mev/c is found to be interpretable only in terms of s-waves, and to have no p-wave component. The isotropy in the differential cross sections, and the constructive interference with Coulomb scattering, at each of the momenta show that the repulsive s-wave character of the K^+-p T = 1 state persists throughout this region. (T.F.H.)

4003 EVIDENCE FOR $\pi^+\pi^-$ RESONANCES AT 395- AND 520-Mev EFFECTIVE MASS. N. P. Samios (Brookhaven National Lab., Upton, N. Y.), A. H. Bachmann, R. M. Lea, T. E. Kalogeropoulos, and W. D. Shephard. Phys. Rev. Letters, 9: 139-42(Aug. 1, 1962).

Four-charged-prong events obtained by the interaction of 4.7-Bev/c π^- mesons with protons are analyzed. Resonances are observed having effective masses of 395, 520, 740 (ρ meson), and 1220 (N_{33}^* isobar) Mev. The 395- and 520-Mev resonances are concluded to be $\pi^+\pi^-$ states. (T.F.H.)

4004 NEW METHOD FOR PRODUCING AND ANALYZING LINEARLY POLARIZED GAMMA-RAY BEAMS. N. Cabibbo (Comitato Nazionale per l'Energia Nucleare, Rome and Università, Rome), G. Da Prato, G. De. Franceschi, and U. Mosco. Phys. Rev. Letters, 9: 270-2 (Sept. 15, 1962).

The new method for the production and analysis of a polarized beam of high-energy gamma rays is based on observable interference effects in high-energy electron pair production on crystals. Due to these effects the absorption rate of very high-energy photons in crystal line matter depends on their linear polarization. Equations are derived for the computation of the polarization and intensity loss. A plot is presented of the intensity loss as a function of the polarization for different values of an efficiency parameter E. Values of E at different energies for the optimum value of the angle α at that energy are tabulated for copper and silicon crystals. Plots are also given of E as a function of α in copper for the photon energy, ω, equal to 6 Bev, and of E as a function of ω at α = 3.7 m rad. Finally, the method by which the device can be used as a polarimeter is described. (H.D.R.)

4005 EVIDENCE FOR A T = 0 π^+-π^- RESONANCE AT 1250 Mev. W. Selove, V. Hagopian, H. Brody, A. Baker, and E. Leboy (Univ. of Pennsylvania, Philadelphia and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 9: 272-5(Sept. 15, 1962).

The Regge-pole elementary particle theory predicts the existence of a spin-2 particle having the quantum numbers of the vacuum and with a mass of the order of 1.0 to 1.4 Bev. The particle could decay into two π mesons and should be observed as a π-π resonance with isotopic spin T = 0. Experimental evidence is presented for the existence of such a particle. Using a 3 Bev/c separated π^- beam and the BNL 20-inch hydrogen bubble chamber, the reactions $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ and $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ were studied. Plots of the data obtained from these reactions are presented and analyzed. It is concluded that there is evidence for a T = 0 particle or resonance, the f^0, at an energy of 1250 ± 25 Mev, with a width of 100 ± 50 Mev. The spin was not determined, but is thought to be either 0 or 2. (H.D.R.)

4006 ELEMENTARY PARTICLES OF CONVENTIONAL FIELD THEORY AS REGGE POLES. M. Gell-Mann (California Inst. of Tech., Pasadena) and M. L. Goldberger. Phys. Rev. Letters, 9: 275-7(Sept. 15, 1962).

Composite states in nonrelativistic scattering theory lie on Regge trajectories corresponding to poles in the anguiar momentum plane that move with varying energy. Composite particles in relativistic field theory are believed to have the same behavior. According to the Regge pole hypothesis, particles like the nucleon also lie on Regge trajectories. An investigation is made to show that the Regge pole boundary conditions are also contained in conventional field theory. Starting with ordinary perturbation theory, formulas are presented that suggest there is no evidence of conflict between the two points of view. (H.D.R.)

4007 COMMENTS ON CHEW'S BOOTSTRAP RELATIONSHIP. F. E. Low (CERN, Geneva and Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 9: 277-9 (Sept. 15, 1962).

G. F. Chew has previously shown the existence of a certain reciprocity between the nucleon and the (3,3) resonance. Chew's equations for the reduced width and P-wave amplitudes are extended to show that the validity of the reciprocity is wider than he has claimed. The reciprocity is independent of the energies and coupling constants of the states, and is more a property of the form of the equations than of the particular solution found in nature. Therefore, the existence of an alternative interpretation of Chew's results is presented. Chew's theory is compared to a Lagrangian model, and their similarities and differences are discussed. (H.D.R.)

4008 MOTION OF A RELATIVISTIC CHARGED PARTICLE. I. Prigogine and F. Henin (Université Libre, Brussels). Physica, 28: 667-88(July 1962). (In English)

A relativistic generalization of the theory of electron extension is presented. A cut-off dependent on electron movement and corresponding to a limitation in the spectral region of the electromagnetic waves coupled to the electron was introduced. The spectral region was modified by the Doppler effect. The equation for slow movements reduces to the classic Lorentz-Dirac equation. The theory thus obtained is Lorentz invariant and finite. The density-current vector corresponds to an electron depending not only on the velocity but also on the acceleration and on a derivative with relation to time. The model developed corresponds to an electron at the relativistic time and deformable. (tr-auth)

4009 THE PHOTOPRODUCTION OF CHARGED PIONS FROM DEUTERIUM. W. R. Hogg (Univ. of Glasgow). Proc. Phys. Soc. (London), 80: 729-37(Sept. 1, 1962).

Relative yields of negative and positive pions produced from deuterium by a bremsstrahlung beam of maximum energy of 320 Mev were measured for six pion energies at an angle of 133° (lab system). The measured negative to positive pion ratios decreased from 1.42 to 1.19 for mean pion energies of 15.3 and 65.5 Mev respectively. These results are compared with dispersion relation theory and other current theoretical predictions. It is found that experimental photoproduction results show evidence for the existence of a T = 1, J = 1 pion-pion resonance. (auth)

4010 POSITRON ANNIHILATION IN METALS. D. Butler (English Electric Co. Ltd., Whetstone, Eng.). Proc. Phys. Soc. (London), 80: 741-54(Sept. 1, 1962).

First-order perturbation theory has been applied to calculate the annihilation rate of positrons in a metal, repre-

sented by a Fermi gas of free electrons. In view of the possibility that a bound positronium atom may be formed, some justification is needed before perturbation theory may be used. Calculations on a simple model show that, owing to the presence of the many electrons in the Fermi gas and the operation of the Pauli exclusion principle, a perturbation expansion may indeed be employed in finding the electron density at the position of the positron. Another simple model is used to investigate the validity of calculating only up to the first order in the perturbation series. Higher orders are found to contribute a relatively small amount to the electron density provided the Fermi momentum is large. The condition is satisfied by aluminum, for which a lifetime of 2.8×10^{-10} sec is estimated. (auth)

4011 THE INELASTIC SCATTERING OF ELECTRONS AT IMPURITIES IN METALS. P. L. Taylor (Cavendish Lab., Cambridge, Eng.). Proc. Phys. Soc. (London), 80: 755-8(Sept. 1, 1962).

The modification of the scattering of conduction electrons due to the thermal motion of impurities is considered. It is shown that, contrary to the calculations made by Koshino in 1960, inclusion of this effect does not sensibly alter the theoretical value of the resistivity. (auth)

4012 THE EFFECT OF COUPLING TO n = 3 STATES ON BORN 1s-2s AND 1s-2p e-H COLLISION CROSS SECTIONS. W. B. Somerville (Univ. College, London). Proc. Phys. Soc. (London), 80: 806-7(Sept. 1, 1962).

Total cross sections for the 1s-2s and 1s-2p excitations are presented and compared with the Born cross sections, the results of Burke and Seaton (1961), and the results of the close-coupling approximation calculations. It is noted that the inclusion of couplings to n = 3 states has a very small effect on the cross sections. (W.D.M.)

4013 INTERFERENCE BETWEEN RAYLEIGH AND NUCLEAR RESONANT SCATTERING IN CRYSTALS. P. J. Black, D. E. Evans, and D. A. O'Connor (Univ. of Birmingham, Eng.). Proc. Roy. Soc. (London), Ser. A, 270: 168-85(Nov. 13, 1962).

A theory developed for the interference was derived in a different form so that allowance can be made for the effect of the energy dependence of the absorption near resonance. The various factors influencing the size of the interference effect for diffraction in pure iron of Fe^{57} γ rays are discussed. General confirmation of the theory was obtained from experimental measurements of the scattering from natural and isotopically enriched iron specimens. Possible applications of the results to crystal diffraction studies are discussed. (auth)

4014 A NEW STAGE OF ELEMENTARY PARTICLE THEORY. Mituo Taketani (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 10-22(1961). (In English)

Elementary particle theory is reviewed and various outlooks of future developments are pointed out. Various models are discussed and the structure of elementary particles is treated. (W.D.M.)

4015 HISTORICAL REVIEW OF THE THEORETICAL INVESTIGATION OF NEW PARTICLES. Yoichi Fujimoto (Tokyo Univ.) and Shuzo Ogawa. Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 23-32(1961). (In English)

An historical review is given of theoretical investigations on new particles mainly concerning contributions from Japanese physicists. It starts from the establishment of the two meson theory and covers up to the proposal of Nakano and Nishijima on the strangeness rule. The authors believe that a way to solve the problem of the internal structure of elementary particles with which we are faced at present can not be looked for without the basis of the understanding in the development of our theoretical knowledge on new particles. (auth)

4016 THE SAKATA MODEL. Ziro Maki (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 33-43(1961). (In English)

General remarks and underlying ideas concerning the composite model approach to the theory of elementary particles are given. Classification of elementary particles and the Nakano-Nishijima-Gell-Mann rule are reviewed. The Sakata model for baryon-meson systems is discussed in some detail and comparison is made with other models. (W.D.M.)

4017 THE FULL SYMMETRY THEORY OF THE SAKATA MODEL. Mineo Ikeda (Hiroshima Univ.), Shuzo Ogawa, and Yoshio Ohnuki. Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 44-65(1961). (In English)

A possible symmetry among the basic particles in the Sakata model is studied. A theory is developed which incorporates such a symmetry in a satisfactory way. Theoretical predictions are compared with experimental information. Some speculations are also made for further progress. (auth)

4018 MASS FORMULA IN THE SAKATA MODEL. Ken-iti Matumoto (Kyoto Univ.), Shoji Sawada, Yoshio Sumi, and Minoru Yonezawa. Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 66-88(1961). (In English)

A mass formula is introduced in the Sakata model and its implications are discussed. The revised form of the mass formula is developed and the energies of full symmetry quantum states, which are represented by the basis vectors of irreducible representations of U, are evaluated in order to compare the theoretical predictions thus obtained with experimental indications. Another approach is suggested to find the masses of particle states of the full symmetry theory. (W.D.M.)

4019 QUANTUM MECHANICAL APPROACH TO THE COMPOSITE MODEL OF ELEMENTARY PARTICLES. Yoshio Ohnuki (Nagoya Univ., Japan), Ziro Maki, and Hiroshi Yamamoto. Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 89-124(1961). (In English)

The structure of composite particles seem to be intimately connected with the nature of more fundamental dynamical laws which will reveal themselves beyond the limit of applicability of the point model. A general formulism for treating the Sakata model by means of quantum field theory is constructed and several consequences are derived, bearing in mind that the theory applied to the present model would have a physical reliability only in the corresponding-theoretical sense. (W.D.M.)

4020 WEAK INTERACTION IN THE SAKATA MODEL. Masami Nakagawa (Nagoya Univ., Japan) and Sadao Oneda. Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 125-63(1961). (In English)

In the Sakata model it will be natural to consider that all the weak processes are caused by the primary weak interactions which exist only among the assumed basic baryons (p,n,Λ) and the leptons (ν,e,μ). A search is made for the possible schemes of such primary weak interactions from the standpoint of the Sakata model through analysis of experimental data. A brief summary is presented of the general kinematical consequences which are obtained to the lowest order of the charge-exchange weak four-fermion interaction, independently of the complicated effects of the strong interactions. The problem of the dynamics of strong interactions in the Sakata model is considered. (W.D.M.)

4021 ON THE STRUCTURE OF LEPTON. Yasuhisa Katayama (Kyoto Univ.) and Mituo Taketani. Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 178-88(1961). (In English)

The phenomenological and logical problems for the lepton structure are considered. The investigations are mainly concentrated on the difference between electron and muon, through the weak phenomena and also the electromagnetic phenomena. The remarkable mass difference between both particles is discussed from the standpoint of field theory. Finally a tentative scheme of the interrelation in the lepton family is proposed. (auth)

4022 ON THE NEUTRINO UNIFIED MODEL FOR ELEMENTARY PARTICLES. Mituo Taketani (Rikkyo Univ., Tokyo) and Yasuhisa Katayama. Progr. Theoret. Phys. (Kyoto), Suppl., No. 19, 189-201(1961). (In English)

The neutrino unified model for elementary particles is proposed and discussed with the connection of São Paulo and Nagoya Models. Since the model stands on the new interpretation of electric and baryonic charges, the consideration is concentrated to the roles of charges. Problems toward the unified theory along this model are also presented. (auth)

Neutron Physics

4023 (KAPL-2225) KERNEL AND PAM—PROGRAMS FOR USE IN THE CALCULATION OF THE THERMAL SCATTERING MATRIX FOR CHEMICALLY BOUND SYSTEMS. F. D. Federighi and D. T. Goldman (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 17, 1962. Contract W-31-109-eng-52. 37p.

A description is given of the KERNEL program, its development, and application for calculating inelastic scattering probabilities of thermal neutrons from chemically bound target nuclei in moderators. The way in which the detailed input data for KERNEL can be obtained with a second program, PAM, according to either the Nelkin model for water or a four-oscillator model for polyethylene is also described. FORTRAN source programs are included for both KERNEL and PAM. (auth)

4024 (KAPL-M-EJB-1) ETC4A—A ONE DIMENSIONAL MONOENERGETIC TRANSPORT PROGRAM. E. J. Brooks, Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 8, 1962. Contract W-31-109-eng-52. 68p.

The program ETC4A, for the Philco 2000, solves the monoenergetic transport equation in slab geometry. Quantities which may be determined are the point by point scalar flux, the scalar flux averaged over regions, angular components of the flux, and currents. Solutions may be obtained which have the accuracy of a P_{32} approximation or less. Sources and neutron scattering are described by either a P_0 or P_1 expansion. A maximum number of 200 spatial mesh points is available for calculations of detailed behavior of the neutron flux. (auth)

4025 (ORNL-3330) A REMARK ON THE SECOND FUNDAMENTAL THEOREM IN ONE-VELOCITY TRANSPORT THEORY. Lawrence Dresner (Oak Ridge National Lab., Tenn.). Oct. 31, 1962. Contract W-7405-eng-26. 23p.

In one-velocity transport theory with linearly anisotropic scattering, the second fundamental theorem always gives an under-estimate of the average nonescape probability of neutrons from critical slabs, spheres, and cylinders if the buckling is calculated with zero extrapolation length. (auth)

4026 (TID-14073) THERMAL FLUX PATTERN IN THE VICINITY OF A MODERATELY STRONG ABSORBING ROD. E. V. R. Rao and Leo Seren (Argonne National Lab., Ill.). Aug. 1961. Contract [W-31-109-eng-38]. 11p. (UAC-5581)

The axial and radial flux patterns of thermal neutrons in and near steel rods in a graphite moderator were studied. It was found that a good fit with experimental data could be found by using the simple diffusion theory modified such that the mathematical diameter of the steel rod is taken to be larger than its actual diameter. The experiment was performed by inserting the steel rod in the center of the Argonaut thermal column. Gold foils were used in mapping the fluxes. (M.C.G.)

4027 NOTE ON AN INVERSION FORMULA BY B. DAVISON. H. H. Clayton (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 1254-8(Sept. 1962). (AECL-1564)

Davison (Can. J. Phys. 35: 576), gave an expression for the constants of integration, in terms of the moments applicable to the spherical harmonics method, in an arbitrary odd order of approximation in cylindrical geometry. This inversion of the matrix which expresses the moments in terms of the constants of integration is most useful in problems involving neutron diffusion in several coaxial regions. His inversion formula contains an error which it is thought useful to correct. A proof of the inversion is sketched, in so far as is needed to establish the correct result. The proof consists in showing that the product of two given matrices is the unit matrix. (W.D.M.)

4028 MEASUREMENTS OF THE TEMPERATURE DEPENDENCE OF THERMAL NEUTRON DIFFUSION PARAMETERS IN WATER AND ICE. Z. Dlouhý and J. Kvitek (Czechoslovak Academy of Sciences, Řež). J. Nucl. Energy Pt. A and B, 16: 376-8(July 1962).

Measurements of the neutron diffusion coefficient, neutron diffusion length, mean lifetime of neutrons, and diffusion cooling constants in water and ice are reported. (W.D.M.)

4029 CHARACTERISTIC SPECTRA IN NEUTRON THERMALIZATION. Akira Furuhashi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 677-84(Oct. 1962). (In English)

The behavior of the neutron energy spectrum in a bare homogeneous moderator after the introduction of a burst of neutrons has been studied theoretically. The problem is reduced to an eigenvalue problem for a self-adjoint integral operator governing the neutron thermalization. In an infinite system, it has been shown that the Maxwellian component of the spectrum does not couple with higher modes which are orthogonal to the former and contribute nothing to the actual neutron density when integrated. The asymptotic neutron spectrum and the diffusion cooling are formulated most conveniently in the present scheme. The formalism is a general one and may be applied to any scattering model with due labor of computations. Numerical calculations have been done for heavy gaseous moderators. (auth)

4030 RESONANCE SELF-SHIELDING IN THE MEASUREMENT OF RADIATIVE CAPTURE CROSS SECTIONS. Lawrence Dresner (Oak Ridge National Lab., Tenn.). Nuclear Instr. & Methods, 16: 176-88(July 1962). (In English)

The resonance self-shielding correction is calculated for the activation produced by a collimated beam of fast neutrons normally incident on an absorbing foil. (auth)

4031 ON THE DISCRETE CO-ORDINATE METHOD IN THE STUDY OF THE SPACE-TIME DISTRIBUTION OF THE NEUTRON FLUX IN A MULTI-LAYER SYSTEM.

V. C. Boffi (Comitato Nazionale per l'Energia Nucleare, Rome and Centro di Studi Nucleari della Casaccia, Rome). Nuovo cimento (10), 23: Suppl., No. 2, 157-83(1962). (In English)

An attempt is made to determine, in the beam of the elementary diffusion theory, the space-time distribution of the flux and current density of neutrons, which from an infinite monochromatic plane source diffuse into a multilayer slab system. The system is considered to contain a finite or infinite number of cells, each consisting of two adjacent slabs of different materials. The mathematical formalism connected with the discrete coordinate method is briefly presented. The space-time distribution of the neutron flux and current density within the given system is studied on the basis of the elementary diffusion theory, neglecting the neutron finite velocity effects. The same problem is qualitatively discussed by including the effects of the neutrons finite velocity. (W.D.M.)

4032 MULTIPLE SCATTERING OF NEUTRONS IN THE STATIC APPROXIMATION. J. H. Ferziger and A. Leonard (Stanford Univ., Calif.). Phys. Rev., 128: 2188-90(Dec. 1, 1962).

It is shown that, within the static approximation, the neutron diffraction pattern from a sample can be interpreted in terms of multiple particle correlation functions. In particular, the relation between double scattering and the three-particle correlation function is derived. Although the formula given cannot be formally inverted to give the three-particle correlation function, it may be useful for making corrections for multiple scattering in experiments. (auth)

4033 TOTAL REFLECTION OF NEUTRONS FROM METALLIC MIRRORS. D. Bally, S. Todireanu, S. Rîpeanu, and M. G. Belloni (Inst. of Atomic Physics, Bucharest). Rev. Sci. Instr., 33: 916-19(Sept. 1962).

Total neutron reflection from Cu, Fe, Cd, and glass mirrors was studied. The variation of the reflection coefficient vs glancing angle for a neutron wavelength of 1.161 Å was measured. The results obtained show that passing from a polished mirror to a ground mirror leads to a fourfold decrease of the reflection coefficient and a threefold increase of the half-width of the rocking curve. The following values for the scattering lengths were obtained: $f_{Fe} = (9.16 \pm 0.13)10^{-13}$ cm; $f_{Cu} = (7.46 \pm 0.15)10^{-13}$ cm; $f_{Cd} = (4.9 \pm 0.2)10^{-13}$ cm. The penetration depth of totally reflected neutrons was measured and a value of 130 Å was found for a copper mirror. (auth)

4034 NEUTRON PHYSICS. Proceedings of the Symposium held at Rensselaer Polytechnic Institute, May 5-6, 1961. M. L. Yeater, ed. Nuclear Science and Technology. A Series of Monographs and Textbooks. New York, Academic Press, 1962. 315p. $12.00.

The physics of reactors and neutron physics fundamental to that field are treated. Topics covered include studies of reactor systems by pulsed neutron techniques, neutron cross sections, crystal lattice dynamics, neutron transport, neutron spectrometry, and plasma physics. Separate abstracts have been prepared for each paper. (W.D.M.)

4035 THE LOW ENERGY CROSS SECTIONS OF FISSILE NUCLIDES. B. R. Leonard, Jr. (General Electric Co., Richland, Wash.). p.3-34 of "Neutron Physics." New York, Academic Press, 1962.

A survey has been made of the experimental data for the cross sections and fission parameters of the fissile nuclides: U^{233}, U^{235}, and Pu^{239}. The best available data have been used to construct the most probable behavior of the low energy cross sections which are presented graphically. It is shown that the most probable 2200-meter/sec parameters of U^{233} and U^{235} form a set of values which are consistent with the results of ratio measurements. The values which are provisionally derived are for U^{233}: $\sigma_{nT} = 587 \pm 3$, $\sigma_{nn} = 12 \pm 3$, $\sigma_{nx} = 575 \pm 4$, $\sigma_{n\gamma} = 49 \pm 2$, $\sigma_{nf} = 526 \pm 4$, $\alpha = 0.0935 \pm 0.0038$, $\nu = 2.502 \pm 0.014$, and $\eta = 2.288 \pm 0.010$, and for U^{235}: $\sigma_{nT} = 694 \pm 4$, $\sigma_{nn} = 16 \pm 3$, $\sigma_{nx} = 678 \pm 5$, $\sigma_{n\gamma} = 99 \pm 4$, $\sigma_{nf} = 579 \pm 6$, $\alpha = 0.172 \pm 0.007$, $\nu = 2.434 \pm 0.019$, and $\eta = 2.077 \pm 0.010$. It is recommended that a least squares adjustment similar to that made for U^{233} by Evans and Fluharty should be made for the U^{233} and U^{235} parameters as a single set. For Pu^{239} the lack of precise determinations of $1 + \alpha$ preclude the development of a set of parameters in the same manner as done for U^{233} and U^{235}. The Pu^{239} parameters of σ_{nf}, ν, and η which can be derived from ratio measurements with U^{235} are shown to have an internal inconsistency of 4.3% when combined with the most probable value of σ_{nx}. On the assumption that the measurements of η are most likely discrepant, the most probable values of the 2200-meter/sec parameters for Pu^{239} are taken to be: $\sigma_{nT} = 1018 \pm 5$, $\sigma_{nn} = 10 \pm 3$, $\sigma_{nx} = 1008 \pm 6$, $\sigma_{n\gamma} = 254 \pm 11$, $\sigma_{nf} = 754 \pm 9$, $\alpha = 0.337 \pm 0.017$, $\nu = 2.89 \pm 0.05$, and $\eta = 2.16 \pm 0.05$. (auth)

4036 TIME-OF-FLIGHT METHODS IN LOW ENERGY NEUTRON CROSS SECTION MEASUREMENTS AT THE MTR. R. G. Fluharty and J. E. Evans (Phillips Petroleum Co., Idaho Falls, Idaho). p.35-63 of "Neutron Physics." New York, Academic Press, 1962.

The neutron cross section program at the MTR, initiated to take advantage of the high flux of the MTR, is discussed. Topics covered include time-of-flight techniques used, comparison of the MTR and linear accelerators, highlights of recent cross section results, and programs under way or to be undertaken. (W.D.M.)

4037 PRESENT STATUS OF INTERMEDIATE ENERGY CROSS SECTION MEASUREMENTS WITH FAST CHOPPERS. J. A. Harvey (Oak Ridge National Lab., Tenn.). p.64-90 of "Neutron Physics." New York, Academic Press, 1962.

The role of fast choppers as time-of-flight spectrometers is briefly outlined. Some of the measurements made with fast choppers at Argonne and ORNL are given. The material is divided into total and partial cross section measurements. Under partial cross sections; capture measurements, scattering measurements, fission measurements, measurement of eta, and capture γ-spectra measurements are discussed. (W.D.M.)

4038 RECENT HIGH RESOLUTION PULSED ACCELERATOR VELOCITY SPECTROMETER RESULTS. W. W. Havens, Jr. (Columbia Univ., New York). p.91-108 of "Neutron Physics." New York, Academic Press, 1962.

Recent high resolution pulsed accelerator velocity spectrometer results obtained at Columbia Univ. are given. Major modifications to the electronic control equipment, made during the building of the new 200-meter flight path, are briefly discussed. Diagrams of the experimental setup are presented. Data are given on several samples of thorium. (W.D.M.)

4039 PARTIAL CROSS SECTION MEASUREMENT WITH THE HARWELL 28-Mev LINEAR ACCELERATOR. F. D. Brooks and J. R. Bird (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.109-23 of "Neutron Physics." New York, Academic Press, 1962.

The Harwell 28-Mev electron linac facility has a pulse repetition frequency of 200/sec, a pulse width of 0.25 μsec, and neutron intensity of $\sim 10^{14}$/sec. The disposition of the 10 flight paths is discussed. A measurement of eta versus neutron energy for U^{235} and an investigation of capture

gamma spectra for different resonances in Pt^{195} are described in some detail. (W.D.M.)

4040 BROOKHAVEN RESPONSIBILITY FOR CROSS SECTION COMPILATION AND REVIEW. Herbert Kouts (Brookhaven National Lab., Upton, N. Y.). p.124-8 of "Neutron Physics." New York, Academic Press, 1962.

The expanded role that Brookhaven has been requested to undertake in connection with collecting and disseminating basic neutron cross section data is discussed. The formal arrangements now existing in order to bridge the gap between the people who measure neutron cross sections and those who use them in one form or another are reviewed. (W.D.M.)

4041 CRYSTAL AND LIQUID DYNAMICS FROM NEUTRON ENERGY DISTRIBUTIONS. Bertram N. Brockhouse (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.129-44 of "Neutron Physics." New York, Academic Press, 1962.

The use of inelastic scattering of monoenergetic beams of slow neutrons to study the dynamics of condensed matter is treated. The particular application is to solids or liquids, but the method can be used for studying molecular or magnetic properties. The work of the Chalk River group has been chiefly directed towards obtaining knowledge of the fundamental dynamical behavior of the atoms in condensed systems. (W.D.M.)

4042 DYNAMICS OF ATOMIC MOTIONS IN LIQUIDS AND COLD NEUTRON SCATTERING. K. S. Singwi (Argonne National Lab., Ill.). p.145-61 of "Neutron Physics." New York, Academic Press, 1962.

Argonne experiments on cold neutron scattering in liquids are discussed. No attempt is made to give a theory for the liquid state, but some interpretation is given of the available experimental results on neutron scattering in liquids on the basis of what might be called physically plausible models of a liquid. (W.D.M.)

4043 VARIATIONAL METHODS IN NEUTRON THERMALIZATION. D. S. Selengut (Knolls Atomic Power Lab., Schenectady, N. Y.). p.162-86 of "Neutron Physics." New York, Academic Press, 1962.

The general formalism and the estimation of adjoint trial functions of the variational methods in neutron thermalization are treated. Some typical problems in neutron thermalization are discussed: the determination of the neutron spectrum in an infinite medium with a uniform source; the spectrum of a decaying pulse of neutrons as a function of time in a finite block of material and the associated thermalization time constant; and the rethermalization cross section and asymptotic decay length at large distances from a localized static source of thermal neutrons. The variational method provides a unified means of calculating these quantities in terms of a few parameters with direct physical interpretations. (W.D.M.)

4044 THEORETICAL INTERPRETATION OF PULSED NEUTRON EXPERIMENTS IN MODERATORS. P. B. Daitch (Rensselaer Polytechnic Inst., Troy, N. Y.). p.187-94 of "Neutron Physics." New York, Academic Press, 1962.

The classes of pulsed neutron measurements discussed are those which involve moderators and in which the neutron energy is in essentially the thermal range. Experiments are considered which utilize the high intensity of the RPI linear accelerator and which may be treated on the time scale of from several μsec up to msec. (W.D.M.)

4045 PROMPT NEUTRON DECAY CONSTANTS OF FAR-SUBCRITICAL HYDROGENEOUS MEDIA. D. R. Bach (Knolls Atomic Power Lab., Schenectady, N. Y.). p.195-214 of "Neutron Physics." New York, Academic Press, 1962. (TID-12778)

A review of subcritical pulsed neutron experiments at KAPL is presented. The experiments described were carried out by using an intensity of only 10^6 neutrons per burst. The facilities permit measurements from far-subcritical to near-critical. The systems used are illustrated and data for various assemblies are given. (W.D.M.)

4046 MODERATION STUDIES BY NEUTRON TIME-OF-FLIGHT. M. J. Poole, E. Barnard, M. S. Coates, and B. J. Rogers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.248-62 of "Neutron Physics." New York, Academic Press, 1962.

At Harwell the pulsed linac has been used in the measurement of neutron spectra, but in addition a reactor subcritical assembly-chopper has been used to study neutron spectra in hot graphite-moderated lattices. A second slow chopper has also been built and successfully used to measure the spectrum in the ZENITH reactor at temperatures up to 600°C. A group working at the John Jay Hopkins Lab. has devised a method of using a neutron chopper in conjunction with a linac to enable measurements to be made in graphite systems which have too long a die-away time to enable the direct pulsing technique to be used. These two approaches to neutron spectrum measurements are examined and the relative value of each is indicated. (W.D.M.)

4047 RENSSELAER POLYTECHNIC INSTITUTE LINAC FACILITY. E. R. Gaerttner, M. L. Yeater, and R. R. Fullwood (Rensselaer Polytechnic Inst., Troy, N. Y.). p.263-88 of "Neutron Physics." New York, Academic Press, 1962.

The linac facility at RPI was established to carry on applied and fundamental research related to the nuclear field. Operating experience is described which was obtained before the linac was shipped to RPI. Layout of the accelerator and associated experimental facilities are illustrated. Characteristics of the linac are given. (W.D.M.)

4048 PRESENT STATUS ON THE FUSION PROBLEM. Henry Hurwitz, Jr. (General Electric Research Lab., Schenectady, N. Y.). p.289-95 of "Neutron Physics." New York, Academic Press, 1962.

The concept of magnetic confinement of high-temperature plasmas has progressed from a theoretical idea to a laboratory reality. Major advances have been made in both the experimental and theoretical aspects of plasma physics, and the area of correlation between theory and experiment is growing rapidly. Some of the recent research on plasma confinement is reviewed briefly. (W.D.M.)

Nuclear Properties and Reactions

Refer also to abstract 4333.

4049 (AFOSR-2531) RESEARCH ON EXCITED LEVELS IN LIGHT NUCLEI USING 1.5 Mev C-W. Serge Gorodetzky (Strasbourg. Université. Institut de Recherches Nucléaires). Jan. 31, 1962. Contract AF61(052)-478. 22p. (AD-274759)

The double gamma emission was studied in the monopole transitions of 6.06-Mev energy in O^{16}, 3.35 Mev in Ca^{40}, and 1.73 Mev in Zr^{90} obtained from the reactions $F^{19}(p,\alpha)O^{16}$ and $Ca^{40}(p,p')Ca^{40}$ and by β activity of a Sr^{90} source, respectively. In the case of O^{16} $T(\gamma\gamma)/T = 2.5 \pm 1.1 \times 10^{-3}$ was found. For Ca^{40} and Zr^{90} upper limits of 2.4×10^{-3} and 1.4×10^{-3} respectively were obtained. Comparisons with theoretical and other experimental values are given. (auth)

4050 (ANL-6551) A PROCEDURE FOR THE EVALUATION OF NEUTRON-SCATTERING CROSS SECTION IN THE INCOHERENT APPROXIMATION. V. Z. Jankus (Argonne National Lab., Ill.). Sept. 1962. Contract W-31-109-eng-38. 29p.

Calculational procedures oriented toward computer application are presented to evaluate the neutron inelastic scattering cross section in the incoherent approximation for a simple cubic Bravais lattice. The differential scattering cross section, the scattering law, or inelastic scattering matrices and transport cross sections for multigroup calculations are evaluated using the contributions of 25 phonons. The inelastic scattering cross section for graphite is calculated as an example of polycrystalline media where the phonon-frequency distribution is dependent on the direction of polarization. (H.D.R.)

4051 (JINR-E-1064) ON BACKWARD SCATTERING OF HIGH ENERGY PARTICLES. D. I. Blokhinssev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1962. 6p.

Further development of earlier work on the backward scattering of high-energy particles is presented. A theoretical analysis of backward scattering is presented, and the results are compared with those obtained in experiments. It is noted that measurements so far made are limited and more extensive and reliable experimental results are required to make a comprehensive comparison. (J.R.D.)

4052 (JINR-P-1070) OBRAZOVANIE YADER S ANOMAL'NYM PERIODOM SPONTANNOGO DELENIYA V REAKTSIYAKH S TYAZHELYMI IONAMI. (On the Formation of Nuclei with Anomalous Spontaneous Fission in Heavy Ion Reactions). S. M. Polikanov, Tung-seng Wang, Kh. Kekk, V. L. Mikheev, Yu. Ts. Oganesyan, A. A. Pleve, and B. V. Fefilov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 7p.

Reactions of heavy ions (Ne^{20}, Ne^{22}, O^{16}, and B^{11}) with U, resulting in a spontaneously fissioning isotope with an abnormally short half life, were investigated. The spontaneously fissioning isotope yield in various reactions was found and the half life measured. It was postulated that a transfer reaction takes place in the case of Ne and O, and the atomic number of the unknown isotope is $2 \leq 97$. (tr-auth)

4053 (KAPL-M-BM-2) A SCHEME FOR THE RAPID GENERATION OF NUCLEAR FEW-GROUP CROSS-SECTIONS AND DIFFUSION PARAMETERS. Barnett Miller (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 1962. Contract W-31-109-eng-52. 63p.

A scheme for the rapid generation of nuclear few-group macroscopic cross-sections suitable for use in digital computer diffusion codes and amenable to hand calculations is developed. The theoretical background is discussed and the empirical nature of the scheme development is explained in detail. The scheme equations in flow form and graphs and constants for use in hand calculations are presented. A comparison of the scheme with rigorous methods is made for three typical situations. (auth)

4054 (NP-12188) THE $Li^7(p,\alpha)\alpha$ REACTION. Y. Cassagnou, G. S. Mani, A. Sadeghi, P. D. Forsyth, and J. M. F. Jeronymo (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1962. 17p. (Notas de Física Vol. IX, No. 9(p.165-80)).

The $Li^7(p,\alpha)\alpha$ reaction was studied up to 4.8 Mev. The angular distribution was fitted to a polynominal of the form $C(1 + A(E) \cos^2 \theta + B(E) \cos^4 \theta)$. The coefficients A(E) and B(E) show enormous variation above 4.0 Mev. The results are discussed in terms of levels in Be^8. The results indicate the presence of direct interaction. (auth)

4055 (NP-12201) THE BETA DECAY OF B^{13}. A. J. P. L. Policarpo, W. R. Phillips, and A. Marques (Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas). 1962. 22p. (Notas de Física Vol. IX, No. 10(p.183-204)).

B^{13} was made in the reaction $B^{11}(t,p)B^{13}$, and its radiations were studied using plastic and NaI(Tl) scintillation spectrometers both singly and in coincidence. The half life was determined as 18.6 ± 0.5 msec. Decay takes place by beta-ray emission to the C^{13} ground state (93%, log ft = 4.01) and to the 3.68-Mev excited state (7%, log ft = 4.53). Limits are set on the decay to other levels in C^{13}. It is concluded that the ground state has spin and parity $^3/_2^-$. No evidence was found for a beta branch to a possible $^5/_2^-$ level in C^{13} which is predicted by the independent particle model. (auth)

4056 (NP-12204) INSTRUMENTACION NUCLEAR. ACELERADORES DE PARTICULA. CURSO DICTADO EN LA ESCUELA LATINOAMERICANA DE FISICA. (Nuclear Instrumentation. Particle Accelerators. Required Course in Nuclear Instrumentation. Particle Accelerators). R. Slobodrian (Argentina. Universidad Nacional de Buenos Aires. Facultad de Ciencias Exactas y Naturales). July 1961. 52p.

The theory and operation of particle accelerators are reviewed. The topics discussed are static accelerators, concepts of the dynamic hamiltonian applied to the motion of charged particles in an accelerating field, accelerators with magnetic field guide, alternating-gradient focussing, accelerators with alternating-gradient and static-field guide, and isochronous cyclotrons. (J.S.R.)

4057 (NP-12247(Pt.A)) NUCLEAR ORIENTATION. Technical Report No. 248. Part A. E. Ambler (Maryland. Univ., College Park). 1961. 103p.

Studies of an assembly of nuclei with non-random spin orientations are discussed. Topics covered include groups and their representations, paramagnetic salts, angular momentum, Coulomb interaction, hyperfine splitting, the spin Hamiltonian, and Kramers' theorem. (M.C.G.)

4058 (NP-12247(Pt.B)) NUCLEAR ORIENTATION. Technical Report No. 248. Part B. E. Ambler (Maryland. Univ., College Park). 1961. 71p.

The concept and methods of nuclear orientation are discussed. The angular distribution of radiation, angular correlations, and nuclear reactions are also considered. (M.C.G.)

4059 (NP-12254) THE ANGULAR DISTRIBUTION OF NEUTRONS FROM THE $C^{12}(t,n)N^{14}$ REACTION AT 1.75 Mev (thesis). Research Report No. S-3. Gaylord T. Hageseth (United States Naval Academy, Annapolis, Md.). Sept. 1962. Contracts NR 015-909 and Nonr-2249(04). 34p.

A C^{12} target was bombarded with tritium at 1.75 Mev using a 2.00-Mev Van de Graaff accelerator. The angular distributions of neutrons leaving N^{14} in the ground state, first excited state, and second excited state were measured. The angular distributions indicated that a direct interaction model is more applicable than a compound nucleus model. (auth)

4060 (NYO-9765) REACTION STUDIES WITH FAST NEUTRONS. D. R. Maxson and R. A. Peck, Jr. (Brown Univ., Providence). Nov. 1, 1962. Contract AT(30-1)-1082. 37p.

A new 350 KV power supply was installed and major modifications of the accelerator were completed. The changes include installation of new focusing and extractor supplies, extension of the accelerator column, and the replacement of the isolation transformer by a motor-generator set. Improved performance at voltages up to 200 KV was obtained, but a modification of the electro-

static lens system will be required for operation at 350 KV. The results of an investigation of the $C^{12}(n,\alpha)Be^9$ reaction and a search for an excited state in He^5 are discussed. Work in progress includes: N^{14} and $O^{16}(n,\alpha)$ angular distribution measurements with counters; studies of $I^{127}(n,d)Te^{126}$ using counters and $I^{127}(n,p)Te^{127}$ using emulsions; and the development of an E × dE/dx pulse height multiplier. (auth)

4061 (PUC-1962-88) (p,α) REACTIONS IN THE $f_{\frac{7}{2}}$ PROTON SHELL AT 18 Mev. R. Sherr (Princeton Univ., N. J. Palmer Physical Lab.). Sept. 1, 1962. Contract [AT(30-1)-937]. 28p.

A review of research on (p,α) reactions with nuclei at 18 Mev is presented. The spectroscopic factor affecting cross sections was calculated. Distorted wave calculations were also made. A comparison was made of theory and experiment for ground state transitions. Formation of excited states in the reaction is discussed. (M.C.G.)

4062 (TID-14059) TABLES OF EFFICIENCIES AND PHOTOFRACTIONS FOR γ-RAYS ON NaI and CsI CRYSTALS. W. F. Miller and William J. Snow (Argonne National Lab., Ill.). Aug. 1961. Contract [W-31-109-eng-38]. 9p. (UAC-5532)

Interaction ratios, detection efficiencies, and photofractions for gamma rays on various size CsI and NaI crystals. The computer program used in the calculations employed the Monte Carlo method in simulation of the actual processes undergone by the incident gamma rays and all subsequent radiation. For the calculations sufficient histories were run to obtain 10,000 primary interactions. (M.C.G.)

4063 (UCRL-6530) EVIDENCE FOR A T = 5/2 STATE IN Cr^{51}. J. D. Anderson and C. Wong (California. Univ., Livermore. Lawrence Radiation Lab.). July 6, 1961. Contract W-7405-eng-48. 8p.

Using time-of-flight techniques to measure the neutron spectra, direct reaction neutrons from the $V^{51}(p,n)Cr^{51}$ were observed for proton bombarding energies above 10 Mev. These neutrons were observed to come from a level (or levels) in Cr^{51} at 6.5 Mev. Results indicated that the assumption of compound nucleus formation in this reaction is valid. It was also concluded that the level at 6.5 Mev in Cr^{51} is excited via a direct reaction, and that the level is the analog of the ground state of V^{51} and is therefore a $T = \frac{5}{2}$ state. (M.C.G.)

4064 (UCRL-6690) NEUTRON-ACTIVATION CROSS SECTIONS. J. A. Miskel, K. V. Marsh, M. Lindner, and R. J. Nagle (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 19, 1961. Contract W-7405-eng-48. 28p.

Neutron-activation cross sections for Hf^{180}, Ta^{181}, W^{186}, Au^{197}, and Th^{232} were measured. The results were compared with those calculated using the statistical theory of nuclear reactions and with results obtained by other investigators. (J.R.D.)

4065 (UCRL-9774) THE NUCLEAR SPIN OF NEODYMIUM-141. Seymour S. Alpert, Burton Budick, Edgar Lipworth, and Richard Marrus (California. Univ., Berkeley. Lawrence Radiation Lab.). July 3, 1961. Contract W-7405-eng-48. 15p.

The spin of Nd^{141} was measured by the method of atomic beams and found to be $\frac{3}{2}$. A lower limit placed on the hyperfine separation of the states with total angular momentum $F = \frac{11}{2}$ and $F = \frac{9}{2}$, $\Delta\nu\,(\frac{11}{2}, \frac{9}{2})$ by second-order perturbation theory shows $\Delta\nu\,(\frac{11}{2}, \frac{9}{2}) \geq 1630$ Mc/sec. (auth)

4066 SOME EXPERIMENTS ON THE ELECTRIC MONOPOLE TRANSITION IN ^{234}U. E. Łożyński and H. Niewodniczański (Inst. of Nuclear Physics, Krakow). Acta Phys. Polon., 22: 91-8(1962). (In English)

The de-excitation of the 811-kev 0^+ level in U^{234} is investigated by means of coincidences with the β-rays from Pa^{234} preceding it. From the measurements performed the ratio of intensities of the 811-kev E0 conversion to the 768-kev E2 ($0 \rightarrow 2$) gamma transition is obtained as 1.30 ± 0.30. The lifetime of the first 0^+ excited state from delayed coincidence experiments is estimated as $\lesssim 0.4 \times 10^{-10}$ sec, which leads to the monopole strength parameter $q > 0.07$. It is pointed out that the 811-kev 0^+ level in U^{234} is a β-vibrational one. (auth)

4067 A DETERMINATION OF THE HALF-LIFE OF C^{14} WITH A PROPORTIONAL COUNTER. Ingrid U. Olsson, Ingvar Karlén, A. H. Turnbull, and N. J. D. Prosser (Inst. of Physics, Uppsala and Atomic Energy Research Establishment, Harwell, Berks, Eng.). Arkiv Fysik, 22: 237-55 (1962). (In English)

The half life of radiocarbon is determined with high accuracy. A proportional counter having an inner diameter of 66 mm is used. It is equipped with a screw making it possible to move one end, thus allowing the counter to have any sensitive length between 12 and 25 cm, so that end effects can be eliminated. The active sample is CO_2 liberated from $BaCO_3$ by thermal action. The sample is carefully diluted 10^9 times with pure, inactive CO_2, and the diluted gas used as counting gas. In one case acetylene is used as counting gas. The wall effect is eliminated by using 2 to 4 atmospheres pressure. Special precautions must be taken to eliminate adsorption errors. The value 5680 ± 40 years must be for the half life of C^{14}, where the indicated uncertainty denotes an estimated probable error of the result. (auth)

4068 THE GYROMAGNETIC RATIO OF THE FIRST ROTATIONAL STATE IN Hf^{178}. Erik Karlsson, Eckart Matthias, and Stanislaw Ogaza (Inst. of Physics, Uppsala). Arkiv Fysik, 22: 257-65(1962). (In English)

The g-factor of the 93-kev state in Hf^{178} is measured by observation of the shift of the angular correlation in external magnetic fields of 45,700 and 25,200 gauss. The result is g = +0.29 ± 0.02. A time-dependent electric quadrupole perturbation is found in the source used by means of an attenuation measurement. The corresponding integral attenuation factors are used for corrections to the ωτ-value. The lifetime of the 93-kev state is found to be τ = 2.16 ± 0.04 nsec. The result is in agreement with theoretical predictions. (auth)

4069 NEUTRON ANGULAR DISTRIBUTIONS FROM THE $Be^9(\alpha,n)C^{12}$ REACTION AT 12.7, 11.3 AND 9.8 Mev. J. Kjellman and A. Nilsson (Research Inst. of National Defence, Stockholm and Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 22: 277-87(1962). (In English)

The angular distributions of the neutrons to the ground state and the first, second, and third excited states of C^{12} are measured for the reaction $Be^9(\alpha,n)C^{12}$ at α energies of 12.7, 11.3, and 9.8 Mev. A measurement at 14.0 Mev is also reported in connection with a survey of the behavior of the reaction in the energy interval 14.0 to 9.8 Mev. (auth)

4070 THE INTERSECTION OF THE LEVEL POWER SURFACES IN HEAVY NUCLEI AND VERY-DIFFICULT α-TRANSITION. S. G. Ryzhanov. Bul. Inst. Politeh. Iasi, 7(XI): 105-10(1961). (In Rumanian)

In order to explain the very difficult α transitions with changes in evenness, a supposition on the intersection of power surfaces in nuclei with a diffusive limit is examined for low levels of some heavy nuclei. Out of the empirical

facts a coefficient of asymmetrical coordinates is obtained that agrees with other methods. (auth)

4071 ELECTRON CAPTURE TO POSITRON RATIOS IN THE DECAY OF Cs^{125} AND Cs^{127}. G. Friedlander and L. Yaffe (Brookhaven National Lab., Upton, N. Y.). Can. J. Phys., 40: 1249-51(Sept. 1962). (BNL-6143)

In the course of some investigations involving the formation of Cs isotopes in 28-Bev proton fission of U, it was found necessary to determine the fractions of Cs^{125} and Cs^{127} decaying by positron emission. In addition to the determinations of the positron and K x-ray emission rates of the Cs isotopes, the number of atoms of these isotopes was determined by measurement of the Xe daughters. (W.D.M.)

4072 THE CONVERSION LINE INTENSITY RATIOS FOR M4 TRANSITIONS IN Xe AND Ba. J. S. Geiger, R. L. Graham, and F. Brown (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 1258-64(Sept. 1962).

Data are presented on the K, L_I, L_{II}, and L_{III} conversion line intensities for the M4 transitions in Xe^{129}, Xe^{131}, and Ba^{137}. The experimental K and L conversion line intensity ratios for these transitions are compared with the theoretical ratios calculated by Sliv and Band (1956) and by Rose (1958). The conversion line intensity measurements were made using the Chalk River iron-free $\pi\sqrt{2}$ β-spectrometer. (W.D.M.)

4073 ANGULAR DISTRIBUTION OF FAST PARTICLES LEAVING A METAL SURFACE IRRADIATED BY AN ION BEAM. E. S. Mashkova and V. A. Molchanov Dokl. Akad. Nauk SSSR, 146: 585-7(Sept. 21, 1962). (In Russian)

Contradictory experimental data are reported in the literature on the angular distribution of fast particles reflected by metallic surfaces; this phenomenon is of interest for explaining the energy transfer by fast ions to the crystal lattice. The problem was studied by determining the angular distribution of a singly-charged, 30-kev Ar beam on Cu, W, and graphite targets. The angular convergence of the argon beam was $\pm 1°$ while the current density was kept at 1 ma/cm^2. In order to measure both the ionic and the neutralized component of the reflected fast particle beam an experimental arrangement similar to that described by V. A. Molchakov et al. (Doklady Akad. Nauk, 136: 801 (1961)) was used. Results indicated that a large portion of the Ar ions are neutralized on the surface of the target. As the scattering angle studied was small, the secondary electron beam was assumed to be closely proportional to the number of the incident fast particles. The distribution curves had identical shapes in all the cases studied. Variations in the microrelief of the target surface affected the current. Theoretical curves plotted on the basis of single collisions of 2 free particles in Coulomb interaction agree well with the experimental data; however, in the case of graphite, multiple collisions must also be taken into consideration. (TTT)

4074 THE NATURE OF THE 531.8 Kev LEVEL IN Er^{167}. B. S. Dzhelepov, M. E. Voikhanskii, A. I. Medvedev, and I. F. Uchevatkin (Mendeleev All-Union Research Inst. of Metrology, USSR). Dokl. Akad. Nauk SSSR, 146: 789-92 (Oct. 1, 1962). (In Russian)

A search was made for the weak 323.9 kev line from the 531.8 kev level to the 207.9 kev level, and for the weak 266.8 kev line from the 531.8 kev level to the 265.0 kev level in Er^{167}. A $\pi\sqrt{2}$, double-focusing spectrometer with a low background was used for this purpose. The Tm^{167} preparation was isolated by a chromatographic separation from a Lu^{167} fraction which originated as a spallation product on bombarding a Ta target with 660 mev protons. The results showed that the 323.9 and 266.8 kev transitions are weaker than the 531.8 kev transition by a factor of 25 at least. The 323.9 and 266.8 kev transitions are a factor of 10^6 less than expected for a single-particle transition as calculated by the Weiskoft-Moshkovskii formula, and a factor of 10^3 less than that calculated by the Neilson formula. It was concluded that the 531.8 kev level $^3/_2{}^+$ of Er^{167} is a collective level, where E1 transitions would be strongly suppressed. The 265.0 kev transition from the 265 kev level to the ground state of Er^{167} was also absent. (TTT)

4075 THE FISSION OF U^{238} BY PHOTONS HAVING A CONTINUOUS SPECTRUM WITH AN $E_{\gamma max}$ OF 35 Mev, AND BY 14 Mev NEUTRONS. A. P. Komar, B. A. Bochagov, and V. I. Fadeev (Ioffe Inst. of Technical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 146: 1051-3(Oct. 11, 1962). (In Russian)

The energy and mass distributions of the heavy fission fragments were determined at angular intervals of 0 to 34° (region I), 34 to 48° (region II), 48 to 60° (region III), 60 to 70° (region IV), and 70 to 80° (region V). A double, impulse ionization chamber with grids, which act as electron collectors, was used in the study. The target of fissionable material, which is transparent to the fission fragments, was placed on the common cathode of the ionization chamber. The neutron or γ beam was directed perpendicularly to the plane of the target, and as a consequence, to the plane of the common cathode. Hence, data could be obtained on the energy of the fission fragment pair, and on the angle θ between the fission fragment and the initial beam. The voltage peaks V_1 and V_2 at the collecting electrodes of both halves of the chamber gave data on the energy of the fission fragments formed during a fission event: $V_1 = \beta\, k_1\, E_1$ and $V_2 = \beta\, k_2\, E_2$. Here E_1 and E_2 are the energies of the fission fragments; k, and k_2 are the amplification coefficients, and β is a dimensional coefficient. The voltage peak V_3 at the common cathode is given by: $V_3 = k_3\, E - k_3\, B\, E^{1.67} \cos\theta$. Here E is the total kinetic energy of the fission fragment pair; k_3 is the amplification coefficient, and B depends on the mass ratio of the fission fragments, on the medium in the chamber, and on the distance between the grid and cathode. The voltage peak $V_4 = k\, E$ can be obtained by multiplying V_1 and V_2 at $k_1 = k_2 = k$. The voltage peak $V_5 = \Delta k E + k_2\, B\, E^{1.67} \cos\theta$ can be obtained by subtracting V_3 from V_4. The signal was amplified after carrying out the subtraction. The value of Δk could be made to be very small. A total of 15,000 fission events by 14-Mev neutrons, and 12,000 fission events by photofission were recorded with a simultaneous record of V_1, V_4, and V_5. The value of E_1 was plotted as a function of E for five angular regions. On fission of U^{238} with 14-Mev neutrons, the total yield of fission fragments and the contribution of fission fragment having a large mass ratio $R = m_H/m_L$ fell with increasing angle θ. The value of R was at a maximum $R_{max} = 1.36$ for all angles. The distribution of fission fragments was anisotropic with a value of $\Sigma N(0°)/\Sigma N(80°) = 1.40 \pm 0.05$. No anisotropy of the fission fragments could be detected during photofission. (TTT)

4076 THE MEASUREMENT OF THE EFFECTIVE RESONANCE INTEGRALS OF URANIUM AND THORIUM USING THE PILE OSCILLATOR OPERATING INSIDE A CADMIUM TUBE. R. G. F. Moore, S. K. Pattenden, and R. B. Tattersall (Atomic Energy Establishment, Winfrith, Dorchester, Dorset, Eng.). J. Nucl. Energy Pt. A and B, 16: 335-50(July 1962). (AEEW-R-57)

The feasibility of determining resonance absorption integrals by performing pile oscillator measurements inside a cadmium tube has been studied. It was concluded that reli-

able results could be obtained with this technique for strong resonance absorbers, but that large corrections were necessary for weakly absorbing materials, particularly those of low atomic weight. The technique has been used to determine the effective resonance integrals of uranium and thorium metal and oxide rods of various sizes. (auth)

4077 PHOTOPROTONS FROM POTASSIUM. Katsufusa Shoda (Tokoku Univ., Sendai), Hachiro Niizeki, Noboru Fujiwara, Akira Okiguchi, Akira Watanabe, and Masao Midera. J. Phys. Soc. Japan, 17: 1083-7(July 1962). (In English)

The energy spectrum of photoprotons from K^{39} induced by 24 Mev bremsstrahlung was observed using nuclear emulsions. The observed spectrum does not agree so well with the calculated one using Weisskopf level density and classical Coulomb barrier height. The choice of a much lower Coulomb barrier height seems to give better agreement with the experimental result. Structures are observed in the energy spectrum. These are discussed using various reaction mechanisms. (auth)

4078 THE DECAY OF 1.25-Min Rb^{82}. Mitsuo Sakai, Hidetsugu Ikegami, and Toshimitsu Yamazaki (Tokyo Univ.). J. Phys. Soc. Japan, 17: 1087-92(July 1962). (In English)

Gamma rays accompanying the decay of 25.0-day Sr^{82} were investigated. Single and coincidence spectra taken with scintillation counters showed the presence of gamma rays with energies of 0.69, 0.78, and 1.41 Mev in the decay of 1.25-min Rb^{82} and their relative intensities were determined. Log ft values were evaluated on the basis of the proposed decay scheme. The allowed beta transitions from the 1+ ground state of Rb^{82} to the ground state and the first and second 2+ states were found to be successively hindered, in accord with Sakai's empirical rule. This problem is discussed in connection with the systematic trend of ft values in the neighboring nuclei. The E2/M1 mixing ratio of the 0.69-Mev gamma ray decaying from the second 2+ state to the first 2+ state were determined from angular correlation pattern of the 0.78 – 0.69-Mev cascade and found to be $-5.8^{+\infty}_{-2.5}$. The negative phase is consistent with the systematic trend of δ in the neighboring nuclei. (auth)

4079 90°-EXCITATION FUNCTIONS FOR THE $N^{14}(d,\alpha)C^{12}$ GROUND-STATE AND FIRST EXCITED STATE REACTIONS. Toshiyuki Ishimatsu (Kyusyu Univ., Fukuoka), Takao Nakashima, Norihisa Kato, and Susumu Morita. J. Phys. Soc. Japan, 17: 1189(July 1962). (In English)

Measurements of the differential excitation functions for the $N^{14}(d,\alpha)C^{12}$ ground-state and first excited state reactions were made at 90° to the incident deuteron beam, in the range of bombarding energies from 1 to 3 Mev. A deuteron beam from a Van de Graaff was used to bombard a 0.28 mg/cm^2 thick melamine layer evaporated on a nickel foil. Alpha particles were detected with a silicon junction detector 2 mm in dia. Results are shown together with related results obtained by several authors. (W.D.M.)

4080 RECOIL-FREE RESONANT ABSORPTION OF 35.5-kev GAMMA RAYS OF Te^{125}. Naomoto Shikazono, Tokio Shoji, Hidekuni Takekoshi, and Poh-Kun Tseng (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 17: 1205(July 1962). (In English)

A carrier-free sample of Sb^{125} was electroplated on a copper foil and then heat treated in a hydrogen atmosphere. Gamma rays were detected by a Xe-filled proportional counter, and both the source and absorber (0.67 g/cm^2) were kept at liquid nitrogen temperature. Results are presented in a curve of transmission as a function of relative velocity between the source and absorber. (W.D.M.)

4081 ON THE ANALYSIS OF PHOTONUCLEAR YIELDS. R. Malvano, A. Molinari, and M. Omini (Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10), 23: Suppl., No. 2, 253-61(1962). (In English)

A collimated gamma beam is considered whose energy distribution corresponds to a normalized bremsstrahlung spectrum. The general method of solution of the Volterra first-kind equation is an iteration procedure, but since this appears rather difficult to carry out, numerical integration methods are elaborated. The photo-difference and Penfold-Leiss methods are discussed. (W.D.M.)

4082 GROUND-STATE HYPERFINE STRUCTURE AND NUCLEAR MAGNETIC MOMENT OF THULIUM-169. George J. Ritter (National Research Council, Ottawa). Phys. Rev., 128: 2238-43(Dec. 1, 1962).

The hyperfine structure of the $4f^{13}6s^2\ ^2F_{7/2}$ ground state of Tm^{169} has been studied by means of the atomic-beam magnetic-resonance method. By the use of multiple transitions, measurements were made from which the nuclear magnetic moment could be extracted without the use of approximate wave functions. Computer analysis of the experimental data gives the following results: $A = -374.1374 \pm 0.0016$ Mc/sec; $g_J = -1.14119 \pm 0.00004$; $g_J' = -(2.478 \pm 0.032) \times 10^{-4}$ (with μ_I expressed in Bohr magnetons); whence $\mu_I = -(0.229 \pm 0.003)$ nm (corrected for the diamagnetic shielding effect of the electrons). (auth)

4083 ENERGY LEVELS OF N^{14} FROM $N^{15}(He^3,\alpha)N^{14*}$. Donald D. Clayton (California Inst. of Tech., Pasadena). Phys. Rev., 128: 2254-61(Dec. 1, 1962).

The energy level scheme of N^{14} in the 4 to 8 Mev range of excitation has been examined by measuring the alpha-particle spectrum from the reaction $N^{15}(He^3,\alpha)N^{14*}$. States are observed at N^{14} excitations of 3.95, 4.91, 5.113 ± 0.008, 5.691 ± 0.008, 5.832 ± 0.008, 6.048 ± 0.012, 6.224 ± 0.012, 6.436 ± 0.012, 7.032 ± 0.010, 7.97, and 8.06 Mev. Unobserved are the now doubtful states reported near 6.70, 7.40, and 7.60 Mev in N^{14}. The implications of a possible state near 7.60 on the C^{12}/C^{13} abundance ratio are discussed and it is concluded that observed isotope abundance ratios are consistent with the finding of this experiment; that is, that such a level does not exist. Angular distributions are presented which show the evidence of different reaction mechanisms to different final states. The reaction $N^{14}(He^3,\alpha)N^{13*}$ also produced resolvable alpha-particle groups to states in N^{13} with excitations of 6.38, 6.91, 7.166 ± 0.008, and 7.388 ± 0.008 Mev. (auth)

4084 REACTION MECHANISM IN $Mg^{24}(p,p'\gamma)$ AT LOW ENERGIES. W. T. Joyner (Hampden-Sydney Coll., Va.). Phys. Rev., 128: 2261-6(Dec. 1, 1962).

The excitation function for the inelastic scattering of protons to the first level of Mg^{24} has been measured for bombarding energies between 2.7 and 4.2 Mev, using an electrostatic accelerator. The 1.37-Mev gamma rays resulting from inelastic scattering were measured at 0°. Six resonances occur in this energy interval, corresponding to levels in Al^{25} at excitation energies of 4.93, 5.09, 5.14, 5.75, 5.81, and 6.15 Mev. Angular distribution measurements were made of the two reaction products, both on and off resonance, and the coefficients of the Legendre polynominal expansions determined. The character of the distributions indicates the adequacy of the compound nucleus model with no evidence of direct interaction effects; the nuclear barrier height thus seems to set an approximate lower limit for the onset of direct interactions. The use of an electrostatic analyzer allowed an energy resolution of 0.05%, and calibration against the Li(p,n) threshold resulted in an absolute energy uncertainty of ±2 kv; this energy calibration allows some simplification of the level scheme in Al^{25}, particularly for excitation energies near 5 Mev. (auth)

4085 NUCLEAR MATTER CALCULATIONS AND PHENOMENOLOGICAL POTENTIALS. K. A. Brueckner (Inst. for Defense Analyses, Washington, D. C.) and K. S. Masserson, Jr. Phys. Rev., 128: 2267-76(Dec. 1, 1962).

The properties of nuclear matter predicted for several different phenomenological potentials by the reaction matrix theory of Brueckner have been calculated. The calculations have shown that potentials which give supposedly equally good fit to scattering data do not necessarily lead to identical nuclear properties. Other approximation methods have been studied to determine their accuracy, with particular emphasis on the iterated Born approximation, and on comparison with the Moszkowski-Scott separation method and with the approximations of Mohling and of Puff. (auth)

4086 INVESTIGATION OF THE INFLUENCE OF ANGULAR MOMENTUM ON FISSION PROBABILITY. John Gilmore, Stanley G. Thompson, and I. Perlman (Univ. of California, Berkeley). Phys. Rev., 128: 2276-81(Dec. 1, 1962). (UCRL-9304(Rev.))

A nuclear emulsion technique has been used to determine total fission cross sections in the following heavy-ion bombardments: (C^{12} + Tm^{169}; O^{16} + Ho^{165}), (O^{16} + Tm^{169}; Ne^{20} + Ho^{165}), (C^{12} + Re^{185}; O^{16} + Ta^{181}), (O^{16} + Re^{185}; Ne^{20} + Ta^{181}). Each pair of bombardments resulted in the same compound nucleus, and excitation energies could be made equal in the two cases by adjustment of bombarding energies. The ratio of the fission cross section to a calculated compound-nucleus-formation cross section, σ_f/σ_c, was taken as a measure of fission probability in each bombardment. Larger fission probabilities were observed to occur for the systems having greater angular momenta. (auth)

4087 DIFFERENTIAL CROSS SECTIONS FOR THE REACTIONS $C^{12}(Li^6,p)O^{17}$ AND $C^{12}(Li^6,d)O^{16}$ FROM 3.4 TO 4.0 Mev. J. M. Blair and Russell K. Hobbie (Univ. of Minnesota, Minneapolis). Phys. Rev., 128: 2282-7(Dec. 1, 1962).

Absolute differential cross sections are presented for the reactions $C^{12}(Li^6,p)O^{17}$ (ground state and first three excited states) and $C^{12}(Li^6,d)O^{16}$ (ground state), for laboratory energies from 3.4 to 4.0 Mev. Total cross sections are about 1 mb at 4.0 Mev. Fluctuations in the angular distributions and total cross sections suggest that the reactions proceed via the compound nucleus F^{18} which is excited to the region of overlapping levels. This is in contrast to the predominantly direct character of the previously studied reaction $C^{12}(Li^6,\alpha)N^{14}$. (auth)

4088 RECOIL RANGE EVIDENCE FOR THE COMPOUND-NUCLEUS MECHANISM IN REACTIONS BETWEEN COMPLEX NUCLEI. John M. Alexander and David H. Sisson (Univ. of California, Berkeley). Phys. Rev., 128: 2288-92(Dec. 1, 1962). (UCRL-10098)

The recoil-range distributions of 4.1-h Tb^{149} produced in a variety of complex nuclear reactions were measured. The targets were Pr^{141}, Ce^{140}, La^{139}, and Ba^{138}; projectiles were C^{12}, N^{14}, N^{15}, O^{16}, O^{18}, F^{19}, and Ne^{20}. In every case the range distributions could be fitted to a Gaussian function. The average range values give evidence for total momentum transfer, and the range straggling is consistent with nuclear evaporation. It is concluded that these reactions are pure compound-nucleus reactions. Excitation energies were approximately 50 to 150 Mev, corresponding to incident energies of 5 to 10.4 Mev per nucleon. (auth)

4089 STUDIES OF 15-Mev INELASTIC DEUTERON SCATTERING. R. K. Jolly, E. K. Lin, and B. L. Cohen (Univ. of Pittsburgh). Phys. Rev., 128: 2292-2302(Dec. 1, 1962).

Angular distributions of inelastically scattered deuterons from Ni leading to many individually resolved states of the final nucleus were measured. The collective 2^+ levels have identical angular distributions, but these are considerably different from those leading to other 2^+, 0^+, and 4^+ levels. Many (but not all) of the latter are strongly similar to each other. The 3^- states in Ni^{60} and Ni^{62} have similar angular distributions, but the 3^- state in Ni^{58} is appreciably different. The predictions of the Blair phase rule on relative phases of elastic scattering angular distributions and those leading to states of positive and negative parity are not valid in Ni, but they apply fairly well to the collective states in Zr and Sn. While the other states in these nuclei have somewhat different angular distributions, the phase rule works well enough to make tentative parity assignments for a large number of levels. The method breaks down badly only for the two phonon levels; all attempts at systematizing data from the latter fail. A survey of energy spectra from 27 elemental and isotopic targets is reported. Corrections to a previous survey are listed. (auth)

4090 INVESTIGATION OF d-s SHELL NUCLEI WITH (d,He^3) REACTIONS. Bibijana Čujec (Univ. of Pittsburgh). Phys. Rev., 128: 2303-9(Dec. 1, 1962).

The possibility of studying nuclear structure by (d,He^3) reactions with 15-Mev deuterons has been investigated and cross sections for transitions to low-lying states measured on a variety of nuclei (O^{16}, F^{19}, Al^{27}, P^{31}, S^{32}, Cl^{35}, Ca^{40}, Ni^{58}, Cu^{63}). Using distorted wave Born calculations, the spectroscopic factors have been extracted and some information obtained on the properties of the low-lying states. The ground states of O^{16}, P^{31}, S^{32}, Cl^{35}, and Ca^{40} are found to be essentially well described by the shell model. In the S^{32} ground state an admixture of about 13% of $s^2_{\frac{1}{2}}$ $d^2_{\frac{3}{2}}$ configuration has been established. The first excited state of Si^{30} (E = 2.24 Mev, J = 2^+) and the second excited state of P^{31} (E = 2.23 Mev, J = $\frac{5}{2}^+$) appear as $d_{\frac{3}{2}}$ hole states. The ratio of spectroscopic factors shows that the Mg^{26} ground state (J = 0^+) and excited state at 1.83 Mev (J = 2^+) are rotational levels of a K = 0 band. The probability of finding the deuteron ground state within the He^3 ground state was found to be ~0.7. (auth)

4091 ANGULAR DISTRIBUTIONS FOR THE $F^{19}(d,n)Ne^{20}$ REACTION. Roger W. Finlay and George E. Owen (Johns Hopkins Univ., Baltimore). Phys. Rev., 128: 2309-12(Dec. 1, 1962).

Angular distributions of neutrons corresponding to transitions to the ground and first (1.63 Mev) excited states in the reaction $F^{19}(d,n)Ne^{20}$ have been measured at incident deuteron energies of 1.0 Mev and 1.3 Mev. Neutrons were detected using a single stilbene crystal spectrometer. Pulse shape discrimination in stilbene was employed to eliminate background radiation. The angular distributions of the ground-state neutrons were consistent with the predictions of nuclear stripping theory when exchange terms were incorporated in the analysis. (auth)

4092 THRESHOLD EFFECT IN ELASTIC SCATTERING ACCORDING TO THE OPTICAL MODEL. W. E. Meyerhof (Stanford Univ., Calif.). Phys. Rev., 128: 2312-19 (Dec. 1, 1962).

An expression is derived for change in the differential elastic scattering cross section caused by the presence of a reaction threshold, in a situation in which it is useful to average over many compound resonances. The derivation is based on the assumptions underlying the optical model and on the usual statistical assumptions made in the evaluation of energy-averaged cross sections. In essence the derivation gives the angular distribution of that part of the fluctuation cross section which is caused by the reaction,

and relates this in a simple way to the reaction cross section. It is shown, although not in a rigorous manner, that for closely-spaced resonances an energy average of the usual Wigner cusp expression, as given by Baz and Newton for example, yields the previously calculated threshold effect on the differential elastic scattering cross sections. Also an expression is given for the threshold effect on the differential elastic scattering cross section in a situation in which the phase shift of each partial wave consists of a part that varies slowly with energy and a part that fluctuates about zero as the energy of the bombarding particle is changed. For simplicity all calculations are restricted to the case of spin-zero target nucleus and spin-zero and spin-one-half bombarding particle. Furthermore, the derivations assume that only one incident partial wave is dominant in the reaction cross section near threshold. The calculations are applied to recent measurements of Wells, Tucker, and Meyerhof of the differential elastic and inelastic neutron cross sections of cerium in the neighborhood of the threshold for excitation of the 1.60-Mev, 2^+, first excited state of Ce^{140}. It is shown that the computed threshold effect appears to account completely for a marked decrease which had been found in the differential elastic scattering cross section of Ce above 1.60 Mev. (auth)

4093 COULOMB EXCITATION WITH Ne^{20} IONS. R. C. Ritter, P. H. Stelson, F. K. McGowan, and R. L. Robinson (Oak Ridge National Lab., Tenn.). Phys. Rev., 128: 2320-31(Dec. 1, 1962).

Neon ions with energies ranging from 8 to 15 Mev have been obtained by the acceleration of doubly and triply charged ions in a 5.5-Mev Van de Graaff. These projectiles have been used to study Coulomb excitation in 18 nuclei ranging from Li^7 to Th^{232}. In particular, the levels of Ti^{47}, V^{51}, Fe^{57}, Ni^{61}, Zn^{67}, Ge^{73}, and As^{75} were investigated. The spin of the 320-kev state of V^{51} is uniquely assigned as $5/2$ and the mixing ratio, $\delta = (E2/M1)^{1/2}$, is $0.52 \pm .07$. Strong evidence is found against previous assignments of $5/2$ for the spin of the 184-kev state in Zn^{67}. The yields and angular distributions of the gamma rays require spin assignments of $3/2$ and $1/2$ for the 184- and 93-kev states, respectively, in Zn^{67}. (auth)

4094 PROPERTIES OF THE 319-kev EXCITED STATE OF Pd^{105}. F. R. Metzger (Franklin Inst., Swarthmore, Penna.). Phys. Rev., 128: 2332-4(Dec. 1, 1962).

Using the high peripheral velocities of an ultracentrifuge as the means of compensating for the recoil energy losses, resonance scattering from the 319-kev level in Pd^{105} has been observed with a Rh^{105} source. From the magnitude of the scattering effect, a mean life $\tau_\gamma = (2I + 1)(0.91 \pm 0.05) \times 10^{-11}$ sec, I being the spin of the excited state, was obtained for the ground-state transition which is a mixture of M1 and E2. The angular distribution of the resonance radiation was found to be of the form $W(\theta) = 1 + (0.25 \pm 0.03)P_2(\cos\theta)$; this eliminated the value $1/2$ for the spin of the excited state. Combining the measured mean life with the B(E2) from Coulomb excitation, the absolute value of the mixing amplitude δ may be restricted to $|\delta| = 0.14^{+0.03}_{-0.02}$. The experimentally observed angular distribution and this value of $|\delta|$ cannot be accounted for if a spin of $3/2$ is assigned to the 319-kev level. Of the two remaining spin values, $5/2$ and $7/2$, spin $7/2$ is favored by the experimental evidence. (auth)

4095 NUCLEAR RESONANCE EXCITATION USING A DIFFRACTION MONOCHROMATOR. E. J. Seppi and F. Boehm (California Inst. of Tech., Pasadena). Phys. Rev., 128: 2334-9(Dec. 1, 1962).

Nuclear resonance scattering from the first excited states in F^{19} and Mn^{55} has been studied with the bent-diffraction-crystal monochromator. The experiment was performed by observing the scattered radiation from nuclei exposed to nearly monoenergetic x rays selected by crystal diffraction from the bremsstrahlung spectrum of an x-ray tube. Gamma rays scattered at 135° from samples of lithium fluoride and manganese placed in the diffracted beam were observed as a function of the incident photon wavelength. With the lithium fluoride sample three measurements were made under different experimental conditions. In each case pronounced resonance peaks 10 to 15% above background were observed. A least-squares analysis of the data gives 109.894 ± 0.005 kev for the energy position of the first excited level in F^{19}. From the observed yield the width of this level was deduced to be $(5.1 \pm 0.7) \times 10^{-7}$ ev. Measurements with a Mn^{55} scattering sample gave 125.95 ± 0.01 kev for the position of the first excited level and $(1.1 \pm 0.3) \times 10^{-6}$ ev for the resonance width. (auth)

4096 POLARIZATION OF 24-Mev NEUTRONS ELASTICALLY SCATTERED FROM C, Al, Fe, Sn, Pb, AND Bi. C. Wong, J. D. Anderson, J. W. McClure, and B. D. Walker (Univ. of California, Livermore). Phys. Rev., 128: 2339-44(Dec. 1, 1962). (UCRL-6946)

Employing the 64% polarized neutron source from the T(dn)He^4 reaction at 30° for an incident deuteron energy of 7.7 Mev, the angular dependence of the polarization for elastic scattering of 24-Mev neutrons from C, Al, Fe, Sn, Pb, and Bi has been measured from 20 to 70° in 5° steps. The "left" and "right" measurements are obtained by precessing the neutron spin magnetic moment plus and minus 90° with a suitably designed solenoid. The measured polarizations are in reasonable agreement with the optical-model predictions of Bjorklund and Fernbach, provided that the sign of the spin-orbit potential agrees with that deduced from the shell model. The magnitude of the spin-orbit potential (25 times Thomas) is in agreement with that deduced from fitting the proton polarization data. (auth)

4097 PHOTONEUTRON CROSS SECTIONS FOR V^{51} AND Co^{59}. S. C. Fultz, R. L. Bramblett, J. T. Caldwell, N. E. Hansen, and C. P. Jupiter (Univ. of California, Livermore). Phys. Rev., 128: 2345-51(Dec. 1, 1962). (UCRL-6913)

The (γ,n) and $(\gamma,2n)$ cross sections for Co^{59} and V^{51} have been measured, using nearly monochromatic photons obtained from the annihilation in flight of fast positrons. The integrated cross sections up to 28 Mev for $\sigma(\gamma,n)$ and $\sigma(\gamma,2n)$, respectively, are 0.447 ± 0.044 and 0.139 ± 0.014 Mev-b for Co, and 0.451 ± 0.045 and 0.106 ± 0.011 Mev-b for V. The minus-second cross sections (σ_{-2}) are 1.82 and 1.56 mb/Mev, respectively, for these elements. The level density parameters a were determined to be 5.49 and 6.18 Mev^{-1}, respectively. The quadrupole moments determined from the compound-nucleus formation cross sections, $\sigma(\gamma,n) + \sigma(\gamma,2n) + \sigma(\gamma,np)$, were found to be 0.94 ± 0.13 and 0.66 ± 0.09 b, respectively, for Co and V. (auth)

4098 $Al^{27}(p,3pn)Na^{24}/C^{12}(p,pn)C^{11}$ CROSS-SECTION RATIO IN THE Gev REGION. J. B. Cumming, J. Hudis, A. M. Poskanzer, and S. Kaufman (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 128: 2392-7(Dec. 1, 1962). (BNL-6270)

The $Al^{27}(p,3pn)Na^{24}/C^{12}(p,pn)C^{11}$ cross-section ratio has been measured at nine energies between 0.4 and 17 Bev. Corrections have been applied for the loss of C^{11} by diffusion from the thin plastic foils which were used, and the effects of this loss on existing data are discussed. From the measured ratios and published absolute cross sections for the $C^{12}(p,pn)C^{11}$ reaction, an excitation function for the standard monitor reaction, $Al^{27}(p,3pn)Na^{24}$, was obtained.

The cross section at 3 Bev was found to be 9.1 ± 0.5 mb, lower than the previously accepted value of 10.5 mb. Cross sections relative to the $Al^{27}(p,3pn)Na^{24}$ cross section were also obtained for the production of Na^{22}, F^{18}, N^{13}, C^{11}, and Be^{7} from aluminum and for Be^{7} from carbon in this energy region. These cross sections are essentially independent of energy between 6 and 28 Bev. An exception is Be^{7} production from aluminum, which increases slightly between 3 and 28 Bev. (auth)

4099 POLARIZED TARGETS AS DIRECT REACTION MECHANISM PROBES. L. J. B. Boldfarb and D. A. Bromley (Yale Univ., New Haven, Conn.). Phys. Rev. Letters, 9: 106-8(Aug. 1, 1962).

A distorted-wave formalism is used to characterize the polarization effects in direct nuclear reactions involving polarized targets and polarized or unpolarized beams. Polarization distributions and correlations are calculated, and the range of applicability of the formulation derived is discussed. (T.F.H.)

4100 SIZEABLE DYNAMIC PROTON POLARIZATIONS. T. J. Schmugge and C. D. Jeffries (Univ. of California, Berkeley). Phys. Rev. Letters, 9: 268-70(Sept. 15, 1962).

Nuclear polarizations as large as 51% were produced for protons in the waters of hydration in single crystals of lanthanum magnesium nitrate, $La_2Mg_3(NO_3)_{12} \cdot 24H_2O$, in which 1% of La^{3+} has been replaced by paramagnetic Nd^{3+}. The method used, preparation of the crystals, the polarization apparatus, and the experimental procedure are described. Results are presented in tabular form along with calculated values of the theoretical ideal polarization. The results indicate that even larger polarizations will be obtained at higher fields and frequencies, and it is possible to produce 50% proton polarized crystal targets for high-energy nuclear scattering experiments. (H.D.R.)

4101 GAMMA-GAMMA DIRECTIONAL CORRELATIONS IN ^{95}Mo. B. Van Nooijen, H. Van Krugten, and G. B. Vingiani (Technische Hogeschool, Delft, Netherlands). Physica, 28: 644-5(July 1962). (In English)

Measurements were made of the directional correlations of the 838-204 and 584-204 kev gamma cascades in Mo^{95}. The result obtained for the 838-204 kev cascade agreed with a spin ½ for the 1042 kev level and an intensity mixing ratio of either Q = 0.78 ± 0.02 or ≤0.02 for the 838 kev transition as well as with a spin ⅜ ($0.27 \leq Q \leq 0.90$). The result for the 584-204 kev cascade was consistent with a spin ½ for the 788 kev level (with $Q \leq 0.05$ or $Q = 0.64 \pm 0.09$) as well as with a spin ⅜ ($0.45 \leq Q \leq 0.78$). (P.C.H.)

4102 ACTIVATION CROSS SECTIONS OF FAST NEUTRON DETECTORS. I. Heertje and A. H. W. Aten, Jr. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica, 28: 661-6(July 1962). (In English)

The cross sections of several fast-neutron detectors were measured in the neutron flux of a radium-beryllium source. The results suggest that the energy spectrum of the neutrons is similar to that suggested by Hess and that the cross-sections published for the reactions $S^{32}(n,p)P^{32}$, $P^{31}(n,p)Si^{31}$, $Al^{27}(n,p)Mg^{27}$, $Ge^{56}(n,p)Mn^{56}$, and $Al^{27}(n,\alpha)Na^{24}$ are sufficiently accurate to be used as a basis for neutron flux measurements. (auth)

4103 THE (p,n) REACTION CROSS SECTION OF COPPER FOR 9.3 Mev PROTONS. K. F. Chackett, G. A. Chackett, and L. Ismail (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), 80: 738-40(Sept. 1, 1962).

The (p,n) reaction cross sections for proton bombardment of natural copper at a proton energy of 9.3 ± 0.3 Mev were measured by an activation method. The results, 480 ± 20 and 895 ± 35 mb respectively for the isotopes Cu^{63} and Cu^{65}, when combined with accepted values of the (p,q) cross sections near this energy give a total reaction cross section of 910 ± 25 mb, in good agreement with results obtained in this laboratory and elsewhere by direct methods. (auth)

4104 ROTATING CO-ORDINATES IN SCATTERING THEORY. A. M. Arthurs and J. T. Lewis (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 269: 585-8(Oct. 9, 1962).

The use of rotating co-ordinates in scattering problems is justified under certain conditions by considering a particular class of unitary equivalent Hamiltonians. (auth)

4105 SOME ATOMIC MASSES AND NEUTRON SEPARATION ENERGIES FOR ISOTOPES OF TIN AND ANTIMONY. Prepublication Copy. 5p.

Mass spectrometer measurements of absolute values for the masses of Sn and Sb isotopes having mass numbers of 116 to 124 are reported. These data, supplemented by total beta-decay energies, are used to calculate neutron energies for these isotopes. (T.F.H.)

4106 PHYSICS ADVANTAGES OF STAINLESS STEEL CORES. Charles N. Kelber (Argonne National Lab., Ill.). 10p. (TID-17262)

To be published in TID-7642 Proceedings of the Symposium on Research Reactor Fuel Element, held in Gatlinburg, Tenn., September 17-19, 1962.

The intermediate nature of the core spectrum was illustrated by examining the energy distribution of fissions in a typical core. The cumulative fission distribution in the center of the core was plotted. An effect of the spatial variation in neutron spectrum is illustrated. The effects of hafnium, europium, cadmium, and stainless steel in the core are discussed. With 37 wt % UO_2 dispersed in stainless steel plates, cores were designed with cycle lengths of 35 to 90 days at 100 Mw. (M.C.G.)

4107 NUCLEAR SPECTROSCOPY. Proceedings of the International School of Physics "Enrico Fermi." XV Course. G. Racah, ed. New York, Academic Press, 1962. 265p. $9.00.

A group of lectures and seminars on nuclear spectroscopy, from a course in the International School of Physics, is presented. Topics covered include mathematical techniques, shell model spectra, theory of collective phenomena in nuclei, beta decay, electromagnetic properties of light nuclei, and theory of nuclear matter. Separate abstracts have been prepared for each topic. (W.D.M.)

4108 MATHEMATICAL TECHNIQUES. G. Racah (Hebrew Univ., Jerusalem). p.1-23 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

The mathematical techniques involved in calculating energy levels of nuclei are discussed. Topics covered include coupling of angular momenta, antisymmetrization, the energy matrix, concept of seniority, the isospin, and the algebra of tensor operators. Both the matrix of the energy, which is a scalar quantity, and quantities which are defined with reference to a system of coordinate axes and which experience a linear transformation when this system rotates, are dealt with. (W.D.M.)

4109 SHELL MODEL SPECTRA IN NUCLEI. I. Talmi (Weizmann Inst. of Science, Rehovoth, Israel). p.24-43 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

Solving the equations of motion of the nucleus, with given mutual interactions, amounts to solving the quantum mechanical n-body problem. In order to make calculations, models of greatly simplified physical systems must be used. The shell model has been successfully applied in many

cases for quantitative calculations of nuclear energy levels. Some of these calculations are described in detail. (W.D.M.)

4110 SELECTED TOPICS IN THE THEORY OF COLLECTIVE PHENOMENA IN NUCLEI. B. Mottelson (NORDITA, Copenhagen). p.44-99 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

A number of phenomena which especially illustrate the occurrence of collective effects in nuclear spectra are discussed. It is shown that essentially all the popularly recognized nuclear collective effects, such as the occurrence of vibrations and rotations, follow from exactly the same features of the nuclear forces that are responsible for the existence of the average shell model potential. The problem of the nuclear collective effects is approached from the point of view of the coupling schemes that are appropriate for the description of configurations consisting of many particles outside of closed shells. (W.D.M.)

4111 BETA DECAY. G. Alaga (Univ. of Zagreb and Inst. Rudjer Boškovic, Zagreb). p.100-63 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

The main characteristics of β-decay processes including half lives, emission spectra, e-ν angular correlations, angular distribution of electrons from polarized nuclei, longitudinal polarizations of the electrons and neutrinos, ratios of electron capture to positron emission, ion recoil spectrum, β-γ angular correlations, β-γ angular correlations with detection of a particular circular polarization of γ-rays, circular polarization of the bremsstrahlung of the electron, and β-γ angular correlation from polarized nuclei are discussed. An attempt is made to formulate a theory as simple as possible which describes these processes and gives the correct properties of the neutrino. (W.D.M.)

4112 SELECTED TOPICS IN THE THEORY OF ELECTROMAGNETIC PROPERTIES OF LIGHT NUCLEI. G. Morpurgo (Universita, Florence). p.164-81 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

The systematics of γ transitions in light nuclei are examined in some detail. General formulas and a survey of the experimental results, the E1 and M1 isotopic spin selection rules, and a short summary of the detailed calculations in the intermediate coupling model are considered. (W.D.M.)

4113 THEORY OF NUCLEAR MATTER. J. Goldstone (CERN, Geneva). p.182-205 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

The theory of nuclear matter is discussed in terms of the Fermi gas model, many-body theory, graphs and Green's functions, Brueckner theory, and superconductivity. (W.D.M.)

4114 TECHNIQUES IN β-DECAY EXPERIMENTS. H. Daniel (Max-Planck-Institut für Kernphysik, Heidelberg). p.206-13 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

A brief review of the methods and techniques used in β-decay work is given. The various methods used to determine the more or less intrinsic properties of β decay are considered. Experiments treated are divided into two classes; parity experiments and classical experiments. Topics discussed include the determination of the longitudinal polarization of β particles, the analysis of γ circular polarization, measurements of the shape of β spectra, and measurements of β-γ directional correlations. (W.D.M.)

4115 NUCLEAR PHOTOEFFECT IN DEFORMED NUCLEI. E. Hayward (National Bureau of Standards, Washington, D. C.). p.214-22 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

The general features of the giant photonuclear resonance are enumerated. The results of some experiments in which the giant resonances for some highly deformed rare earth nuclei were studied are described. A series of experiments is considered in which both the total photon absorption and scattering cross sections were measured and the connection between the two kinds of results demonstrated. The relations between the scattering and absorption cross sections for deformed nuclei are discussed. (W.D.M)

4116 THE INTERACTION OF ^{3}He AND ^{3}T WITH LIGHT NUCLEI. H. D. Holmgren (Naval Research Lab., Washington, D. C.). p.223-37 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

Qualitative features of the He^3-induced reactions expected on the basis of the compound nucleus and direct interaction models are examined. Typical experimental data found for these interactions are looked at in detail. Some rather general and qualitative statements about the nature of the interaction, in some regions of bombarding energy, are made. (W.D.M.)

4117 COURSE ON NUCLEAR SPECTROSCOPY. S. Jha (Tata Inst. of Fundamental Research, Bombay). p.238-46 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

Results are presented from measurements of the beta-decay energy of the neutron-deficient isotopes: Tl^{204}, Tl^{202}, Tl^{201}, Tl^{199}, Tl^{200}, Tl^{198}, Tl^{197}, and Tl^{195}. Nuclear levels and decay schemes are reported for the following isotopes: $I^{128} \rightarrow Xe^{128} \leftarrow Cs^{128}$, $Cs^{129} \rightarrow Xe^{129}$, $I^{132} \rightarrow Xe^{132} \leftarrow Cs^{132}$, $Xe^{133} \rightarrow Cs^{133} \leftarrow Ba^{133}$, $Pr^{140} \rightarrow Ce^{140}$, $Pr^{144} \rightarrow Nd^{144} \leftarrow Pm^{144}$, $Pm^{148} \rightarrow Sm^{148} \leftarrow Eu^{148}$, $Nd^{149} \rightarrow Pm^{149} \rightarrow Sm^{149}$. (W.D.M.)

4118 PSEUDOSCALAR INTERACTION IN THE β-DECAY OF ^{144}Pr. D. Tadić (Inst. Ruder Boskovic, Zagreb). p.247-53 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

The treating of the pseudoscalar interaction in the theory of β decay is very sensitive to the model used for the relativistic nuclear hamiltonian. Starting with a hamiltonian in configuration space for the nucleons, transition probabilities are evaluated in two different ways. One method is to make a non-relativistic approximation to the hamiltonian by using a Foldy-Wouthuysen transformation, the other method consists of starting with the hamiltonian. (W.D.M.)

4119 M1-TRANSITIONS IN ^{14}N. I. Unna (Weizmann Inst. of Science, Rehovoth, Israel). p.254-8 of "Nuclear Spectroscopy." New York, Academic Press, 1962.

It is pointed out that it is convenient to use effective operators in the analysis not only of energy levels, but also of other characteristics of nuclei such as quadrupole moments and electric transitions. It is shown that even for M1 transitions this approach is efficient. This is true although the matrix elements have no radial part, and the form of the operator is known. The case of N^{14} is used to illustrate this approach. (W.D.M.)

Particle Accelerators

Refer also to abstracts 2768 and 2771.

4120 (BNL-6512) FUTURE PROGRAM FOR THE CERN PS AND THE BROOKHAVEN AGS, MINUTES OF A MEETING HELD AT THE BROOKHAVEN NATIONAL LABORATORY, SEPTEMBER 10-14, 1962. J. W. Bittner, ed. and comp.—H. N. Brown and A. W. Maschke, comps.

(Brookhaven National Lab., Upton, N. Y.). Contract [AT (30-2)-Gen-16]. 208p.

The proceedings of the meeting were compiled and edited from tape recordings and notes made during the meeting. A total of 28 papers is included for which separate abstracts were prepared. (J.R.D.)

4121 (BNL-6512(p.1-12)) THE AGS EXTERNAL BEAM. G. K. Green (Brookhaven National Lab., Upton, N. Y.).

A description of the AGS external beam equipment is presented. A review of nomenclature concerning the facility is included along with discussions of the design and functions of the kicker, septum, and ejector. (J.R.D.)

4122 (BNL-6512(p.13-16)) THE CERN EXTERNAL PROTON BEAMS. H. G. Hereward (European Council for Nuclear Research, Geneva).

Fast and slow ejection schemes and their application to the CERN PS are outlined. It is noted that plans were made to use the fast ejection system for the r-f separated beam. Further study of the slow ejection scheme is planned. (J.R.D.)

4123 (BNL-6512(p.17-23)) RESULTS OF CERN BEAM STUDY GROUP. B. D. Hyams (European Council for Nuclear Research, Geneva).

The group considered aspects of beam utilization in areas such as secondary particle experiments, the simultaneous sharing of the beam on several targets, and a wobbled proton orbit scheme for production of high intensity low momentum beams. (J.R.D.)

4124 (BNL-6512(p.24-8)) SMALL PRODUCTION ANGLES USING IRON PIPES, TARGETS IN MAGNETS AND "PETRUCCI MAGNETS." H. G. Hereward (European Council for Nuclear Research, Geneva).

Design of a shielding system for low-momenta beams at angles less than 9° by the use of iron pipes is discussed. The secondary beam is shielded in such an arrangement from the fringing fields of the following magnet. Other discussion is included on the Petrucci magnet installed in the CERN which focuses the beam in the vertical plane and bends the beam through an angle of 9°, giving a total of 16° between the circulating and secondary beams. Achievement of small production angles by placing targets inside synchrotron magnets is also discussed. (J.R.D.)

4125 (BNL-6512(p.29-31)) PRELIMINARY THOUGHTS ON MATCHING EXTERNAL BEAMS TO TARGETS. R. Armenteros (European Council for Nuclear Research, Geneva).

A discussion of CERN circulating beam instabilities and their effects on target acceptance is presented. (J.R.D.)

4126 (BNL-6512(p.32-6)) COLUMBIA-BROOKHAVEN PLANS FOR FUTURE NEUTRINO EXPERIMENTS. M. Schwartz (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.).

Design of an experiment in search of the intermediate boson or W particle is described. Using the experimental set-up as described, the W particles will be recognized only if boson production is larger than ordinary two-pion production. Future experiments are also discussed concerning cross sections as function of energy and momentum transfer and neutrino experiments with bubble chambers. (J.R.D.)

4127 (BNL-6512(p.37-9)) PRESENT PLANS FOR THE NEUTRINO EXPERIMENT. P. Germain (European Council for Nuclear Research, Geneva).

An outline of plans for shielding a neutrino experiment at CERN is presented. A summary of previous work on this project is included. (J.R.D.)

4128 (BNL-6512(p.40-2)) IMPLICATIONS OF THE NEUTRINO EXPERIMENT ON SCHEDULING. G. L. Munday (European Council for Nuclear Research, Geneva).

A discussion concerning the effects of neutrino scheduling on the CERN Synchrotron is presented. The pre-neutrino phase, the ejected beam and experiment proper, and the post-neutrino phase are considered. (J.R.D.)

4129 (BNL-6512(p.43-5)) SOME FURTHER FIGURES CONCERNING THE NEUTRINO EXPERIMENT. B. D. Hyams (European Council for Nuclear Research, Geneva).

Estimates of interaction rates were made which indicate that 2 or 3 events per day in the bubble chamber can be observed by experimenters. It is not clear what this estimate means in terms of analyzable events. Other factors which may affect the neutrino experiments are also discussed. (J.R.D.)

4130 (BNL-6512(p.46-9)) AN EXPERIMENT TO SHOW THE EFFECTS OF MAGNET DISPLACEMENTS ON THE EQUILIBRIUM ORBIT OF THE AGS SHORTLY AFTER INJECTION. J. W. Bittner (Brookhaven National Lab., Upton, N. Y.).

Data gathered in an experiment in which equilibrium orbit displacements in the AGS were effected by simulated magnet displacements are compared with similar computed data. (J.R.D.)

4131 (BNL-6512(p.50-6)) CALCULATION OF EFFECTS OF MAGNET MISALIGNMENTS ON THE EQUILIBRIUM ORBIT. E. D. Courant (Brookhaven National Lab., Upton, N. Y.).

Results of calculations concerning the equilibrium orbits of 100 identical accelerators each with a random set of magnet displacement bumps are presented. The peak displacement of each of these machines was plotted in the form of a histogram. The procedure was repeated with different sets of bumps. The machine was also used to calculate corresponding equilibrium orbits, compare these with an unperturbed orbit, and find the rms displacement and peak displacement in each case. (J.R.D.)

4132 (BNL-6512(p.57-61)) IDEAS FOR FUTURE MACHINE STUDIES AT CERN. H. G. Hereward (European Council for Nuclear Research, Geneva).

A discussion of proposed work on machine development at CERN is presented. The proposed project involves measurements connected with the behavior of the closed equilibrium orbit at injection. (J.R.D.)

4133 (BNL-6512(p.62-71)) IDEAS FOR FUTURE MACHINE STUDIES AT BROOKHAVEN. G. K. Green (Brookhaven National Lab., Upton, N. Y.).

A discussion of AGS problems to be investigated soon, and results of past measurements which have a bearing on these problems are presented. Measurements include those on equilibrium orbits and injection orbits. Modifications include installation of vertical steerage coils to aid in targeting, multiturn injection to increase machine admittance, and development of instrumentation to check beam component effects. (J.R.D.)

4134 (BNL-6512(p.72-5)) DC BEAM SEPARATORS AT CERN. G. L. Munday (European Council for Nuclear Research, Geneva).

Design of the presently-used CERN d-c beam separator is discussed along with the newly-designed rectangular d-c beam separator. (J.R.D.)

4135 (BNL-6512(p.76-93)) DC SEPARATORS AT BROOKHAVEN — PRACTICE AND PLANS. R. A. Beth (Brookhaven National Lab., Upton, N. Y.).

A discussion of presently-used d-c separators at Brookhaven is presented. The first separators built used cylin-

drical vacuum chambers. A newer type, one of which is presently used, employs a rectangular vacuum chamber. A total of seven such units are planned for a total cumulative length of 45 meters. (J.R.D.)

4136 (BNL-6512(p.94-8)) RADIOFREQUENCY BEAM SEPARATORS AT CERN. H. G. Hereward (European Council for Nuclear Research, Geneva).

Development of r-f separators at CERN is discussed. The separator consists of two r-f deflecting structures separated by a drift space and a quadrupole focusing lens system. The present status of the separators is discussed along with a new development for particle momentum analysis. (J.R.D.)

4137 (BNL-6512(p.99-102)) EXPERIMENTAL USES OF RF SEPARATED BEAMS. R. Armenteros (European Council for Nuclear Research, Geneva).

A discussion is presented concerning the uses of high energy separated beams such as those associated with measurements of elastic events, events in the form A + B → C + D, inelastic events with low multiplicity in the form P + P → P + P + π^0, and high multiplicity measurements. Resonance experiments in which such beams are used are also noted. (J.R.D.)

4138 (BNL-6512(p.103-12)) THE BROOKHAVEN RF PARTICLE SEPARATOR. H. Hahn (Brookhaven National Lab., Upton, N. Y.).

Design of an r-f particle separator similar to the one proposed for CERN is described. The available length between the machine and bubble chamber is 143 meters compared with about 150 meters at CERN. Other design information concerning beam transport system and the deflecting mode is included. (J.R.D.)

4139 (BNL-6512(p.113-27)) THE FUTURE OF BUBBLE CHAMBERS. W. B. Fowler (Brookhaven National Lab., Upton, N. Y.).

A discussion concerning the present status of bubble chambers and some developments which appear likely to occur soon is presented. It is noted that bubble chambers of higher magnetic field strength are needed and development work in this area is discussed. Properties of superconductors are also discussed. (J.R.D.)

4140 (BNL-6512(p.128-33)) FUTURE OF SPARK CHAMBER WORK. J. W. Cronin (Princeton Univ., N. J.).

A review of spark chamber development is presented. Future trends are also discussed and it is noted that they are almost certain to increase in sophistication, size, and cost. Examples of future experiments which can be done most profitably with spark chambers are listed and discussed. (J.R.D.)

4141 (BNL-6512(p.134-47)) PROBABLE TRENDS IN "ON LINE" COMPUTERS. L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.).

It is noted that future techniques are likely to be developed toward experiments characterized by higher momenta and intensities. It appears likely that detectors will be required which can operate in high fringing fields resulting from the use of high field super conducting magnets. In some respects spark and bubble chambers are more useful than counters, however counters are characterized by good time resolution and high counting rates. They are also useful in high-energy particle identification. Discussions are included concerning Cherenkov counters, solid state detectors, and scintillation hodoscopes. (J.R.L.)

4142 (BNL-6512(p.148-61)) HIGH ENERGY SEPARATED BEAM FOR THE 80 INCH CHAMBER. M. S. Webster (Brookhaven National Lab., Upton, N. Y.).

A separated beam is described which extends a distance of 450 ft from the target at the AGS I-10 straight section to the 80-in. H_2 chamber. An effective separator length of 100 ft exists in the beam. It is thought that the beam will separate and transmit an adequate number of K mesons from 3 to 5.5 Bev and P^- up to 8.5 Bev. The range for π^+ is about the same as for P^- while the π^- upper limit is about 10 Bev. Targeting, beam angle, and beam optics are discussed and a diagram of the physical layout of the beam is included. (J.R.D.)

4143 (BNL-6512(p.162-9)) BEAM TRANSPORT ELEMENTS AT CERN. J. A. Geibel (European Council for Nuclear Research, Geneva).

Work done by the CERN study group concerning magnet design and development is described. Power supplies for CERN are also described. (J.R.D.)

4144 (GNL-6512(p.170-4)) BEAM SHARING. J. Spiro (Brookhaven National Lab., Upton, N. Y.).

It is noted that direct development of equipment for this purpose has been limited. Existing control devices used for beam sharing arrangements are described along with modifications and developments in the AGS. (J.R.D.)

4145 (BNL-6512(p.175-81)) RADIOACTIVITY IN THE MAGNET ENCLOSURE AND TARGET AREAS. R. J. King (Brookhaven National Lab., Upton, N. Y.).

Dose rate measurements made inside the ring during AGS operation are discussed along with residual activity measurements. (J.R.D.)

4146 (BNL-6512(p.182-7)) EFFECT OF AGS RADIATION ON TRANSISTORS. R. J. Orgass (Brookhaven National Lab., Upton, N. Y.).

An investigation of the causes for failure in the AGS saturating power supply transistors is described. It is concluded that radiation is the cause of failure, and investigation aimed at finding an optimum location for the transistor bank is discussed. (J.R.D.)

4147 (BNL-6512(p.188-91)) REMOTE HANDLING OF TARGETS. C. R. Flatau (Brookhaven National Lab., Upton, N. Y.).

Aspects of target handling in future operations of the AGS are discussed. Expected increases in intensity and increased operation time require target component changes by remote methods. A robot or remote controlled roving manipulator appear to be feasible for this use. (J.R.D.)

4148 (BNL-6512(p.192-4)) TARGET BUILDING FLOOR LAYOUT. W. G. Walker (Brookhaven National Lab., Upton, N. Y.).

A description is presented concerning the AGS new target building. A diagram which illustrates the arrangement of beams from the F-10, F-20, and G-10 target locations is included. (J.R.D.)

4149 (MURA-649) TRANSVERSE SPACE CHARGE EFFECTS IN PARTICLE ACCELERATORS (thesis). Dornis C. Morin, Jr. (Wisconsin. Univ., Madison). Aug. 10, 1962. Contract AT(11-1)-384. 162p.

An analysis of transverse space charge effects in particle accelerators is made by means of the Boltzmann equation. With suitable assumptions a closed set of moment equations was obtained which describes the behavior of the beam. It was found that the motion of the center of the beam is independent of the space charge forces and that space charge effects cannot put the beam onto an integral resonance. Conditions were obtained for an approximate stationary solution for which the center and width of the beam remain constant. It is shown that, in the absence of magnetic field errors, the beam width

oscillates if the conditions for a stationary solution are not satisfied and that this oscillation is always stable. A linear theory for the effect of field gradient errors on the beam width for small perturbations from the stationary solution indicates that unstable resonances may exist. Some possible ways of extending the analysis are discussed. (auth)

4150 (TID-17065) THE UNIVERSITY OF MICHIGAN 83-INCH CYCLOTRON. Progress Report No. 9, July 1, 1962–September 30, 1962. W. C. Parkinson and R. S. Tickle (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). Oct. 1962. Contract AT(11-1)-921. 4p. (ORA-03763-9-P)

The fabrication of two gradient coil assemblies was completed, and the main Al vacuum chamber was installed and operated. Continued work on construction of the r-f system and on measurements related to two beam focusing magnets is reported. Fabrication of the ion source was completed and design of the electrostatic deflection system was finished. Other systems and items completed include the water cooling system, remote control circuitry, and television. (J.R.D.)

4151 (TID-17228) CYCLOTRON PROGRAMS FOR A SMALL COMPUTER. T. I. Arnette, H. G. Blosser, M. M. Gordon, and D. A. Johnson (Michigan State Univ., East Lansing). Apr. 1962. Contract [AT(11-1)-872]. 9p.

A functional description of the various MSU cyclotron computer programs is given. The routines may be useful as a guide for construction of similar programs. (auth)

4152 (TID-17246) ACCELERATION OF PARTICLES INTO STABLE ORBITS IN AN ISOCHRONOUS THREE-SECTOR CYCLOTRON. M. M. Gordon and H. G. Blosser (Michigan State Univ., East Lansing). May 1962. Contract [AT(11-1)-872]. 28p.

Results are presented from digital computer studies on the properties of accelerated orbits in the central region of a three-sector, isochronous cyclotron. In these computations an idealized electric gap of zero width has been used and two acceleration rates, 280 and 140 kev/turn, have been considered. With 280 kev/turn a relatively large phase space area (orbit center distribution) is transmitted through the $\nu_r = 3/2$ resonance with only a modicum of distortion; with 140 kev/turn the transmitted area is still ample, but the distortion is markedly greater. In both cases axial focusing is achieved; $\nu_z \cong 0.05$ (280 kev/turn) and $\nu_z \cong 0.035$ (140 kev/turn) are the effective, initial focusing frequencies observed. (auth)

4153 (TID-17247) FIXED-POINT ORBITS IN THE VICINITY OF THE $\nu_r = N/3$, N/4, AND N/2 RESONANCES. M. M. Gordon (Michigan State Univ., East Lansing). Mar. 1962. Contract [AT(11-1)-872]. 40p.

The fixed-point (closed) orbits associated with cyclotron sector resonances are significant because they substantially define the main features of the radial phase space diagrams such as the stability limits. A fairly detailed and rather general calculation of these orbits is carried out for the $\nu_r = N/3$, N/4, and N/2 resonances. In each case formulas are given for the fixed-point orbits that are suitable for numerical calculations. Among the general results obtained are the following. The net fourth-order "frequency-shifting" term in the Lagrangian is essentially zero for an isochronous field at all energies (thus, the N/4 resonance, and to a lesser extent the N/5 resonance, are unstable). The cubic terms in the Lagrangian, all by themselves, can produce not only the N/3 resonance, but also the N/4 and higher-order resonances as well. The behavior of the N/2 resonance resembles more closely the N/4 resonance than the N/3 case. (auth)

4154 (TID-17248) THE ELECTRIC GAP-CROSSING RESONANCE IN A THREE-SECTOR CYCLOTRON. M. M. Gordon (Michigan State Univ., East Lansing). Apr. 1962. Contract [AT(11-1)-872]. 36p.

The theory of accelerated orbits in the median plane of a sector-focused cyclotron is developed using a Lagrangian formalism. The equation for the radial oscillations about the instantaneous equilibrium orbit is reduced, by suitable transformation, to that for a simple oscillator of frequency ν_r driven by perturbations arising from the electric gap-crossing mechanism. For a three-sector magnet and a "two-sector" dee-geometry, these perturbations have Fourier components in resonance with the radial oscillation frequency ν_r, which is always close to unity in a medium-energy machine. The effects of these perturbations are calculated and discussed. The results of computer studies of accelerated orbits in three-sector fields are presented which demonstrate the effects of the gap-crossing resonance under various conditions. These results are discussed with the aid of the theory. The data indicate that a first-harmonic correction field of 3 to 10 gauss can be used to counteract the gap-crossing resonance effects. (auth)

4155 (TID-17283) CENTRAL ORBIT PROGRAM FOR A VARIABLE ENERGY MULTI-PARTICLE CYCLOTRON. M. Reiser (Michigan State Univ., East Lansing). Mar. 1962. Contract [AT(11-1)-872]. 24p.

In a variable energy multi-particle cyclotron, programming the beam on the first turns faces the difficulty that large readjustments of source, puller and defining slit positions may be necessary when the operating conditions are changed. Two distinct solutions of a central orbit program, constant dee-voltage and constant orbit geometry, are discussed with respect to ion capture efficiency, feasibility of readjustments and applicability of the similarity theorems. Theoretical analysis shows that the range of acceptable starting phases depends essentially on transit time and space charge effects in the first accelerating gap and may change considerably when turning from first to higher harmonic acceleration. As a result of calculations, several diagrams are presented as a guide to accomplish necessary readjustments of central geometry. (auth)

4156 THE IOWA STATE UNIVERSITY 1.5 Mev UNDERGRADUATE CYCLOTRON. Daniel J. McGuire (Iowa State Univ., Ames.). Proc. Iowa Acad. Sci., 68: 474-82 (1961).

A general description is presented of a small cyclotron built and used by the Iowa State University Physics Department. This machine is the first operating small cyclotron capable of useful nuclear reactions to be built by an undergraduate group. Specifications of the machine are given. A short review is given of cyclotron action, and a description is presented of some of the auxiliary equipment used in the cyclotron laboratory. (auth)

4157 EXPERIMENTAL PROGRAM WITH THE IOWA STATE UNIVERSITY UNDERGRADUATE 1.5 Mev CYCLOTRON. Ronnie R. Burns (Iowa State Univ., Ames). Proc. Iowa Acad. Sci., 68: 483-91(1961).

The Iowa State University 1.5-Mev cyclotron experimental program is divided between cyclotron technology and nuclear physics experiments. Accelerator technology work is carried out in the determination of the shape of the resonance curve as a function of the magnetic field strength and radius, the determination of magnetic tune-down as a func-

tion of radius, and the measurement of the vertical excursions of the beam. Nuclear physics experiments are performed with the light elements. (auth)

4158 PROTON ORBIT CALCULATIONS FOR THE IOWA STATE UNIVERSITY CYCLOTRON. Alfred H. Mueller (Iowa State Univ., Ames). Proc. Iowa Acad. Sci., 68: 492-501(1961).

Equations governing the proton beam in a small cyclotron are described, and calculations carried out on the Iowa State University cyclotron are reported. These calculations relate the intensity of the proton beam to changes in the magnetic field of the cyclotron and give the beam height as a function of the radius drawn from the center of the dee box. It is found that changes in the magnetic field strength of only a few gauss can result in a large reduction of the beam strength. Calculations of the beam height show that the beam height changes little with changes in the magnetic field, but rather that the beam height is almost completely determined by the radial derivative of the magnetic field. (auth)

4159 MAGNETIC LENS SYSTEM OF UNIT MAGNIFICATION FOR HIGH ENERGY CHARGED PARTICLES. L. Marshall (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 33: 919-21(Sept. 1962). (BNL-6064).

A magnetic lens system designed from studies made with computing machines has been built and used at the Brookhaven cosmotron. It collected pions of 1020 Mev/c mean momentum produced at a target in the external proton beam, selected a narrow momentum bandwidth from a continuous momentum spectrum, recombined the selected momenta, and refocused the pions to an image of unit magnification. The effective solid angle of acceptance was 5.04×10^{-3} sr and the momentum band pass width was ±30 Mev/c. The measured particle yield on 1 $in.^2$ at the focus was 5×10^5 for 6×10^{10} internal 3 Bev/c protons; 27% were positive pions and 73% were protons. (auth)

4160 GAS FLOW REGULATOR FOR AN rf ION SOURCE. B. L. White, L. P. Robertson, K. L. Erdman, and J. R. MacDonald (Univ. of British Columbia, Vancouver). Rev. Sci. Instr., 33: 1111-12(Oct. 1962).

An apparatus is designed for regulating the plasma density in an ion source for beam injection in a Van de Graaff accelerator. The plasma density is stabilized by maintaining the oscillator power output constant by means of a servo system controlling the pressure in the discharge tube. The gas flow rate is controlled by the power dissipation in the thermal leak heater. (D.L.C.)

4161 OPERATING EXPERIENCE WITH THE R.P.I. LINAC. E. R. Gaerttner, M. L. Yeater, and R. R. Fullwood (Rensselaer Polytechnic Inst., Troy, N. Y.). IRE (Inst. Radio Engrs.), Trans. Nucl. Sci., NS-9: No. 5, 23-6(Nov. 1962).

The R.P.I. Linac, one of the most powerful electron accelerators in the world, has been in operation for several months. It has been operated at 130 megawatts peak power and at average beam power of 50 kilowatts for sustained runs. Evidence of pulse shortening has been observed only at currents of 0.8 ampere for pulse widths of 4.6 microseconds. A detailed discussion of performance is presented as well as current improvements. (auth)

Plasma Physics and Thermonuclear Processes

4162 (AD-274266) MODULATED ELECTRON BEAM DIAGNOSTICS IN PLASMAS. Final Report. T. W. Johnston (RCA Victor Co., Ltd. Research Labs., Montreal). Jan. 1962. Contract AF19(604)-7246. 54p.

The feasibility of modulated electron beam diagnostics in warm plasmas was applied to an actual system. It was concluded that, since the scattering of the beam electrons by neutral particles forces the use of high beam voltages which, in turn, makes the bunching length impracticably long, the diagnostic would be useful only in discharges at low gas densities and relatively high electron densities. The experiment was not tried in such a plasma system. Strong electron density oscillations were detected by a fast-acting microwave system in the apparently steady hot-cathode argon discharge. Optical studies and a plot of oscillation frequency vs gas pressure showed that the oscillations were examples of the well-known moving striations. (auth)

4163 (AD-27515) CESIUM PLASMA STUDIES FOR THERMIONIC ENERGY CONVERSION. Second Semi-Annual Technical Summary Report. R. G. Knechtli and J. Y. Wada (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). Apr. 1962. Contract Nonr-3501(00). 43p.

A study of the conditions of sheath formation on the surface of the thermal cesium plasma generators used for recombination measurements was performed. Results obtained with two-emitter plasma generators lead to tentative, conclusions, i.e., that the rates of both electron loss and ion loss from the plasma back to the emitter are surprisingly low. These results are explained by speculating that electron trapping takes place in the plasma, whose potential would be positive with respect to the emitters; in addition, the probability of neutralization of ions returning to the emitter may be lower than predicted by the Saha-Langmuir equation. Low-frequency oscillations in a cesium plasma column with a plasma emitter at one end and a collector at the other were studied in the collector circuit of the movable probe tube. These oscillations were conclusively related to the existence of a negative resistance characteristic in the emitter-collector circuit. This negative resistance characteristic was caused by changes in plasma density with collector voltage. A preliminary theory accounting for these phenomena was evolved. (auth)

4164 (AFCRL-62-91) AN INVESTIGATION OF THE ABSORPTION OF ELECTROMAGNETIC RADIATION BY A PLASMA OF SUB-CRITICAL DENSITY. Final Report. A. Olte, M. L. Barasch, E. G. Fontheim, A. E. Heins, J. C. King, and E. K. Miller (Michigan. Univ., Ann Arbor. Radiation Lab.). Feb. 1962. Contract AF19(604)-8032. 104p. (AD-274014; ORA-4386-2-F)

The design of an experiment is given which employs an inverted coaxial diode geometry to investigate the absorption of electromagnetic radiation below and above the plasma frequency. Data obtained when a pure electron stream was introduced into the system were analyzed but cannot be completely explained. Difficulties encountered in introducing and ionizing a real gas are discussed. The results of an investigation concerning the form of the electron distribution function in such an experimental arrangement are reported. The process of free-free absorption is discussed, and expressions are given for the absorption coefficient in the presence of ions and neutral atoms or molecules. These are shown to be essentially equivalent to the results of the usual Lorentzian theory. (auth)

4165 (CERN/FSG/15) EUROPEAN STUDY GROUP ON FUSION. EIGHTH MEETING, AMSTERDAM, MAY 16, 17, AND 18, 1962. NOTES. (European Council for Nuclear Research, Geneva). Aug. 15, 1962. 132p.

Summaries of the papers presented at the meeting are given. Included are papers concerning the facilities at various research laboratories and technical presentations concerning electron densities and plasma motion in theta-pinches, plasma heating, microinstabilities and losses, plasma resonances, r-f confinement, microwave technology, radial plasma gun development, pinch development, magneto-gas dynamics, and other aspects of fusion research. (J.R.D.)

4166 (DCAS-TDR-62-10) SPECTRAL RADIANCE AND EMISSIVITY OF PLASMA AND TEMPERATURE DETERMINATION. Allen E. Fuhs (Aerospace Corp., El Segundo, Calif.). Jan. 10, 1962. Contract AF04(647)-930. 9p. (AD-273590; TDR-930(2230-03)TN-2)

A method used to determine the temperature of a flame is to measure its spectral radiance and spectral emissivity. The ratio of these two measured quantities provides a point on the blackbody curve, if the flame is effectively in equilibrium. Sufficient measurements are taken throughout a wavelength region to trace out an experimentally determined blackbody curve. This curve is compared with a series of curves that have been plotted by using different temperatures in Planck's radiation law. The temperature used to obtain the plotted curve that best coincides with the experimentally determined blackbody curve is designated as the flame temperature. The technique appears to be feasible for continuous plasma sources with temperatures up to about 15,000°K. The method provides a temperature determination procedure utilizing many different radiative processes. Hence, the temperature determined by this method reflects more clearly the energy content and energy distribution. (auth)

4167 (DCAS-TDR-62-46) PROGRESS REPORT ON THE AC STABILIZED THETA PINCH. Stanley L. Leonard and Mitchell H. Dazey (Aerospace Corp., El Segundo, Calif.). Feb. 12, 1962. Contract AF04(647)-930. 13p. (AD-274700; TDR-930(2210-02)TN-1)

Attempts to produce dynamic stabilization of the plasma column in a theta-pinch experiment by means of an r-f azimuthal magnetic field are described. The r-f currents used were produced by the damped oscillatory discharge of high-voltage capacitors through the inductance of the plasma column. The maximum r-f current (at the end of the first half cycle) was 13,900 amperes at 2.5 megacycles. No evidence of stabilization was obtained. A pulsed 1 megawatt vacuum-tube oscillator, designed to produce an undamped r-f current, is being constructed. Spectrographic investigation of the continuum intensity, the variation of the continuum intensity with wavelength, and the Stark broadening of the D_β Balmer line yielded values for the electron temperature and the electron (ion) density. (auth)

4168 (GCA-TR-62-4-A) STUDY OF RECOMBINATION PHENOMENA. VOLUME II. RECOMBINATION IN PLASMA. Final Report. H. E. Stubbs, Alec Dalgarno, David Layzer, E. N. Ashley, Ali Naqvi, and George Victor (Geophysics Corp. of America, Bedford, Mass.). Feb. 1962. Contract AF29(601)-4143. 293p. (AD-273694; AFSWC-TDR-62-11(Vol. II))

Information on the physics of plasma recombination is presented. The radiative transition probabilities for a number of atoms and ions are given. The information is presented in sections on stationary plasma, atomic processes in recombining plasma, atomic transition probabilities, generalization for the screening theory and the Hartree-Fock theory, relativistic effects in heavy atoms, statistical description of complex spectra, and properties of expanding gases. (J.R.D.)

4169 (MIT-28-T-P) AN EXPERIMENTAL INVESTIGATION OF A MAGNETOGASDYNAMIC ACCELERATOR. William T. Hogan (Massachusetts Inst. of Tech., Cambridge). Apr. 1962. Contract Nonr1858(25). 110p. (AD-276060)

A d-c crossed-field accelerator was attached to the downstream end of a 1.5 in. diameter combustion driven shock tube using either argon or air as the working fluid. The applied magnetic field was varied from 0 to 15 kilogauss, and the electrical power from 0.5 to 11 megawatts. The shock heated gases were accelerated to a maximum of three times their original velocity. Open circuit voltages were a few percent lower than the ideal values for the circular channel. The electrical conductivity of the plasma was measured upstream and downstream of the accelerator. By apportioning the current between the test gas and the cooler gases that follow, the momentum and energy could be balanced. The momentum and energy conversion efficiency were found to be in the range of 60 to 90 and 40 to 70%, respectively. With the exception of a few percent, all of the electrical energy delivered to the test gas could be accounted for. (auth)

4170 (ML-900) AN INVESTIGATION OF NONLINEAR EFFECTS IN PLASMAS. Scientific Report No. 41. Bruno F. Ludovici (Stanford Univ., Calif. Microwave Lab.). Apr. 1962. Contract AF19(604)-1930. 179p. (AD-275281; AFCRL-62-164)

The motions of free electric charge carriers, as they exist in a plasma, are governed by nonlinear relationships between velocity and electric field intensity. The resulting spectral decay of propagating modes may, depending on boundary conditions and operating parameters, manifest itself in the form of nonlinear mixing, cumulative traveling-wave interaction, and parametric amplification. A theoretical and experimental investigation of this phenomenon, as it relates to the so-called plasmaguide configuration, is presented. The plasma employed in this study is furnished by the positive column of a low-pressure mercury vapor discharge. It is enclosed in an elongated glass tube which is surrounded by a slotted metallic sleeve. This geometry permits the propagation of electromechanical plasma modes, which are characterized by a low phase velocity and low dispersion for frequencies small compared with the plasma frequency. It is therefore possible to inject at the collector end of the tube two signals of different frequencies which, travelling at almost the same velocity, interact cumulatively over many wavelengths. This nonlinear interaction is studied by means of a sampling probe which moves along the waveguide slot. (auth)

4171 (NBS-7280) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Tenth Progress Report, April 1, 1962–June 30, 1962. (National Bureau of Standards, Boulder, Colo.). 22p.

Measurements of a-c susceptibility were made on niobium wire. It was inferred from results that the individual domain walls do not move in response to the a-c measuring field. At 4° the sample appeared perfectly diamagnetic up to about 9 kgauss. The energy gap in niobium was measured between 4 and 10°K by means of electron tunneling using a differentiation circuit. The steady-state magnet was operated several times to obtain magnetoresistance data. The pulsed magnet power supply is operational to a limited extent. Previously developed gas bearing principles were applied to a turbine expander operating as part of a small-capacity helium refrigeration system. (M.C.G.)

4172 (NP-12203) ANALYSIS OF THE AXIALLY-SYMMETRIC HARD MAGNETIC PISTON. A. B. Schaffer,

R. H. Huddlestone, and R. X. Meyer (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). Oct. 1, 1959. 23p. (PRL-9-24)

The use of a magnetic piston to push plasma through a duct is analyzed. The magnetic piston is formed by sending a current step down a capacitively loaded helical transmission line which is entwined around the plasma duct. The radial component of the fringing B-field associated with the current step interacts with the conducting plasma to produce a body force in it. The fringing B-field thus acts as a piston on the plasma. The magnetic piston is analyzed by a model which enables properties of the system such as plasma pressure and velocity to be computed in terms of design parameters. The analysis is for the steady-state case (the velocity of the piston equals the plasma velocity). The analysis involves the simultaneous solution of the energy balance for the system together with the normal shock relationships. Numerical computations are presented for design parameters for the cases in which capacitors are originally charged and uncharged, using hydrogen at 300°K as the plasma. (N.W.R.)

4173 (NP-12230) A RAPIDLY RESPONDING $2\frac{1}{2}$ MM MICROWAVE SET-UP. Rijnhuizen Report 62-06. L. TH. M. Ornstein and C. A. J. Hugenholtz (Stichting Voor Fundamenteel Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Aug. 1962. 10p.

A microwave screening and detection system was designed to study rapidly varying plasma parameters at high noise levels. A reflex klystron was used as a power source. The millimeter waves were focused by lenses to a narrow parallel beam of about 1-cm diameter and were thus propagated in free space over a distance of the order of one meter. The lenses were made out of clean paraffin wax. Crystal rectifiers were used as screening. The various response times involved resulted in a total rise time of about 7 μsec. Testing in the vicinity of a violent gas discharge indicated the adequacy of the screening. (M.C.G.)

4174 (PPL-TR-62-16) SPECTROSCOPIC STUDIES OF IMPLODING PLASMA RINGS IN DETONABLE GAS MIXTURES. Kenneth M. Foreman and Maurice E. Levy (Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.). July 30, 1962. Contract AF49(638)-552. 18p.

Spectroscopic observations were made of the flow field behind a cylindrical hypersonic wave front resulting from an imploding electrical discharge into an initially low pressure quiescent gas. Sub-microsecond resolved spectra were obtained by use of a quartz prism monochromator-photomultiplier detector system with photographic recording of an oscilloscope displayed output signal. Electrically produced plasma rings were established in detonable as well as non-reactive gases. Strong indications were observed that exothermic reactions, as evidenced by H_2O emission, proceed in $H_2 + \frac{1}{2}\ O_2$ reactant mixtures within less than one microsecond under certain initial low pressure conditions. A reaction threshold at 1 mm Hg pressure was found for the particular reaction vessel used. Time-integrated spectrometer photos support the conclusions reached with the transient spectra analysis equipment. (auth)

4175 (RADC-TDR-62-87) THE ABSORPTION OF MICROWAVE RADIATION IN A PLASMA WHOSE ELECTRON DENSITY VARIES LINEARLY WITH DISTANCE. Technical Report No. 2. G. F. Herrmann (General Telephone and Electronics Labs. Inc., Mountain View, Calif.). Feb. 1, 1962. Contract AF30(602)-2452. 63p. (AD-274126)

The absorption of microwave radiation normally incident on a semi-infinite plasma whose density varies linearly from zero to infinity is calculated for a wide range of density gradients and electron collision frequencies, and represented by a single family of curves. This family can be reduced to a single curve which represents the absorption with good accuracy. To test applicability of this data to more general types of plasma profiles, the absorption was computed for various configurations in which the semi-infinite plasma was modified by a variety of boundary conditions at various distances from the cut-off point. The results indicate that the absorption depends most strongly on conditions near cut-off. The data calculated for the semi-infinite plasma is applicable to other types of plasma whose density varies smoothly from zero to infinity. (auth)

4176 (TID-17197) CONSERVATIVE TRAPPING MECHANISMS. Technical Report No. 6. D. L. Lafferty and B. N. A. Lamborn (Florida. Univ., Gainesville). Oct. 1962. Contract AT(40-1)-2783. 16p.

An analysis is made of conservative trapping mechanisms in a static mirror field. The discussion is specialized to the tangential injection of particles in the midplane. The analysis is based on single-particle dynamics in a conservative system. The adiabatic conditions can be violated in two distinct ways: a random exchange of energy between transverse and longitudinal motion can occur due to characteristic loops in the particle trajectory; a second-harmonic angular perturbation in the midplane field produces parametric resonance in the longitudinal degree of freedom and results in energy transfer from transverse to longitudinal motion. Energy tends to be absorbed in the longitudinal degree of freedom until the resonance conditions are no longer satisfied. This tendency toward the accumulation of energy in longitudinal motion arises from the asymmetry of the equations of motion; energy is transferred to longitudinal motion by virtue of an unstable solution of the Mathieu equation and in the opposite direction by ordinary resonance. Computer studies of the coupled nonlinear equations of motion of a single particle verify the analytic prediction of rapid growth of the longitudinal oscillation. (auth)

4177 (UCRL-6572) THE INITIATION THRESHOLD AND SOME CHARACTERISTICS OF PLASMA DIODE OSCILLATIONS. Raymond Fox and William Gust (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 10, 1961. Contract W-7405-eng-48. 7p.

The initiation threshold of plasma diode oscillations as a function of voltage, current density, and pressure is presented along with some observed general characteristics. The oscillations at an average output voltage of about 1.4 volts appeared to require appreciably more current density than at higher or lower output voltages. For a current density of one amp/cm^2 and at an output voltage of 1.4 volts, the pressure must be less than about two microns to obtain oscillations. For a given pressure and output voltage, when the current density was increased by an increase in cathode temperature, the waveform was first nonrepetitive for a current density slightly greater than the initiation threshold, then became smooth and repetitive for higher current densities, and again became nonrepetitive for still higher current densities. (M.C.G.)

4178 (UCRL-6632) A POWER RELATION FOR A PLASMA. D. D. Reagan (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 22, 1961. Contract W-7405-eng-48. 6p.

In addition to interactions involving diffusion and drift, each charged particle species in a plasma exchanges energy with the electromagnetic field by a process analogous to betatron acceleration. It is shown that, in a uniform plasma, the expression describing this latter interaction is unaffected by collisions. (auth)

4179 (UCRL-6879) PLASMA DYNAMICS. S. A. Zwick (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1962. Contract W-7405-eng-48. 137p.

Material is presented on the development of pertinent electromagnetic theory, a discussion of individual particle motions from a classical viewpoint, a derivation of the Boltzmann equation, and a development of the hydromagnetic approach to plasma problems. Topics covered include: magnetic flux, Maxwell's equations, the Gaussian system, electromagnetic potentials, field properties, electromagnetic field reaction, influence of the field reaction, particle motions in a plasma, application of the adiabatic approximation, a problem in collective motion, Coulomb collisions, and collision effects in a plasma. (M.C.G.)

4180 (UCRL-7046-T) ORBITAL ANALYSIS OF STABILITY FOR A ZERO THICKNESS, INFINITE LENGTH "E-LAYER." Alvin M. Saperstein (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 1962. Contract [W-7405-eng-48]. 26p.

The stability of an infinitely long "E-Layer" of zero thickness was investigated by examining the equations of motion of the disturbed electron orbits instead of the usual perturbation expansion of the Vlasov equation. A general dispersion relation was derived, valid for magnetically driven disturbances, which holds for arbitrary perturbations perpendicular to the equilibrium orbits. As a special case, azimuthally symmetric, radial disturbances were considered and it is shown that almost all configurations will exhibit a large wavelength instability. If tangent (pitch angle) ~1, the configuration will also suffer short wavelength radial instabilities. (auth)

4181 (UCRL-10294) CONTROLLED THERMONUCLEAR RESEARCH SEMIANNUAL REPORT, JANUARY–JUNE 1962. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Livermore. Lawrence Radiation Lab.). July 20, 1962. Contract W-7405-eng-48. 118p.

Progress is reported on the Pyrotron (magnetic mirror) program, the Astron program, Livermore pinch program, plasma research, theoretical and basic experimental plasma physics, and engineering and technological development. (M.C.G.)

4182 (AEC-tr-5524) UNIVERSAL INSTABILITY OF A MAGNETICALLY CONFINED PLASMA. A. A. Galeev, V. N. Oraevskii, and R. Z. Sagdeev (Akademiya Nauk S.S.S.R. Institut Yadernoi Fiziki, Novosibirsk). Translation of "Universal'naya Ustoichivost Magnitnogo Uderzhaniya Plasmy" from a Paper Presented at Culham Conference on Plasma Stability, September 1962. 21p.

It is shown that a low pressure plasma ($p \ll H^2/8\pi$), confined by a magnetic field, is "universally" unstable with respect to local short-wave perturbations which do not distort the magnetic field, for any ratio between the spatial temperature and density gradients d ln T/d ln n. An analog of a similar "universal" instability in the hydrodynamic approximation is the instability related to finite thermal conductivity along the magnetic field. (auth)

4183 ON NEGATIVE ABSORPTION IN AN ELECTRON-ION PLASMA WHEN RADIATION TAKES PLACE BY FREE-FREE TRANSITIONS. R. Q. Twiss (Univ. of Sydney). Astrophys. J., 136: 438-41(Sept. 1962).

A rebuttal is given of Browne's criticisms of Twiss's proof that negative absorption can never take place in an electron-ion plasma when radiation is produced by free-free transitions. It is shown that Browne's own theory gives an expression for the absorption coefficient that does not correspond to thermal equilibrium when the electron velocity distribution is Maxwellian. It is concluded that Browne's theory is wrong and his conclusions invalid. (auth)

4184 ON THE QUESTION OF MASER ACTION IN A GAS PLASMA. P. F. Browne. Astrophys. J., 136: 442-4 (Sept. 1962).

A reply is made to Twiss's criticism (Twiss, R. Q. 1962, Ap. J., 135: 438) of an earlier paper by the author (Browne, P. F. 1961, Ap. J., 134: 963). With regard to Twiss's criticism of the original argument—that since electrons of velocity less than the peak velocity of the Maxwellian distribution curve are losing energy by stimulated emissions at a rate greater than they are gaining energy by absorptions when one inserts a Maxwellian distribution function, then conditions cannot be equilibrium conditions—the answer to this appears to be that equilibrium conditions do prevail although this is true. (W.D.M.)

4185 FRAMING CAMERA STUDIES OF THE Z-PINCH IN NITROGEN. F. L. Curzon and R. J. Churchill (Univ. of British Columbia, Vancouver). Can. J. Phys., 40: 1191-1207(Sept. 1962).

The Z-pinch discharge in nitrogen was studied by means of a high-speed framing camera. Pressure dependence of pre-pinch striations and electrode effects is reported. Development of Rayleigh-Taylor instabilities after the first pinch is verified, and the dispersion relationship is evaluated for the fastest growing m = 0 mode at a pressure of 100 μ Hg. (auth)

4186 WAVES IN WARM QUIESCENT PLASMAS. T. W. Johnston (RCA Victor Research Labs., Montreal). Can. J. Phys., 40: 1208-44(Sept. 1962).

The comparison is made between the analyses of waves in a plasma which use perturbation theory, the Cartesian tensor or spherical harmonic expansion, and the integrated velocity moment equations. When the wave phase velocities are much greater than the average particle thermal velocities and when collision frequency is independent of velocity, then to first order in thermal transport terms, the three approaches give the same answer for plane waves, except for the phenomenon of Landau damping. Neglecting such damping and remembering the restriction on phase velocity, the use of integrated moment equations can then be justified in attacking non-planar wave problems. First-order relativistic effects are also considered. (auth)

4187 KINETIC EQUATION DESCRIBING IRREVERSIBLE PROCESSES IN IONIZED GASES. ADDENDA AND CORRECTIONS. T. Y. Wu and R. L. Rosenberg (National Research Council, Ottawa). Can. J. Phys., 40: 1251-3(Sept. 1962). (NRC-6937)

Corrections, clarifications, and amplifications are given for the original article, Can. J. Phys. 40: 463. (W.D.M.)

4188 DRIFT INSTABILITY OF A NONHOMOGENEOUS PLASMA IN A MAGNETIC FIELD. B. B. Kadomtsev and A. V. Timofeev. Dokl. Akad. Nauk SSSR, 146: 581-4 (Sept. 21, 1962). (In Russian)

The drift instability of a nonhomogeneous plasma located in a homogeneous magnetic field was investigated. It is shown that a nonhomogeneous isothermal plasma in a strong magnetic field is unstable with regard to drifting wave motions whose transverse wave lengths are about equal to the average Larmor radius, ρ_i. Accordingly, the disturbances are strongly extended along the direction of

the magnetic lines of force and the investigated instability can exist only if the longitudinal wave length, L, is greater than the transverse one, a. Since the transverse wave length for disturbances with insufficiently small a/L is about ρ_i and the oscillation time is $a/\rho_i v_i$ then it is supposed that following the instability path there occur pulsations which cause a plasma diffusion perpendicular to the magnetic field. The coefficient of this diffusion is approximately $\rho_i^2 v_i/a$ and is found to decrease as H^{-2} with increasing magnetic field. (TTT)

4189 RELATIVISTIC NON-LINEAR THEORY OF PLASMA OSCILLATIONS. Louis Gold (Univ. of Michigan, Ann Arbor). J. Electron. Control, 13: 1-12(July 1962).

Nonlinear theory of plasma oscillations is extended into the threshold relativistic region where radiation damping can be neglected. A general characterization of the stationary oscillatory modes is performed in terms of a phase-space analysis with a comparison of the nonrelativistic behavior. Two procedures are offered for delineation of the amplitude-dependent frequency of the fundamental vibration. One of these is readily adopted to the zero-current limit, allowing a development already featured for the relativistic harmonic oscillator. Thus regimes requiring relativistic classical or quantum mechanical treatment are identified. In general, very-high-density plasmas require classical relativistic treatment, although tenuous astrophysical plasmas, where extremely large amplitudes of ion-electron motion can be accommodated, also may be included. The relativistic quantum analysis enters when the plasmon energy approaches the rest of the mass energy of the vibrating charge. A critique of studies of nonlinear plasma oscillations is set forth, and a method for solution of a related class of nonlinear differential equations is presented. (auth)

4190 THE DECAY OF THE ELECTRIC CONDUCTIVITY IN A MOVING HYDROGEN PLASMA. M. Sakuntala (Benares Hindu Univ., Varanasi, India) and A. von Engel. J. Electron. Control, 13: 13-22(July 1962).

An electrically driven shock tube filled with pure hydrogen at pressures between 0.5 and 8 mm Hg is fitted with internal cold probes arranged at different positions in the expansion tube, in order to observe oscillographically the voltage pulse produced between the probes by the plasma shock wave passing a magnetic field up to 5000 gauss strength. The peak value of the open circuit probe voltage ($\leq$60 v) rises strictly linearly with the field, and the flow velocity of the shock wave is proportional to the condenser voltage and inversely proportional to the square root of the ambient gas pressure and distance between probes and discharge tube. The voltage-time integral taken at different probe positions agrees with the magnetic flux linked with the plasma wave. The (ionic) plasma resistivity as a function of the pressure is found to have a minimum dependence on the probe position; its value is lower, the larger the probe distance and the higher the condenser's energy. This minimum arises from an increase in charge concentration in the gas with rising pressure, which results from a conversion of flow and potential energy to ionization and compression; beyond the minimum a rising pressure reduces the charge concentration and increases the resistivity, since, on account of the lower flow velocity, the gas temperature in the shock front is gradually reduced. (auth)

4191 TRANSVERSE PLASMA WAVES AND THEIR INSTABILITY. F. D. Kahn (Univ. of Manchester, Eng.). J. Fluid Mech., 14: 321-35(Nov. 1962).

Linearized equations are derived for disturbances in an infinite plasma without an imposed magnetic field. It is shown that besides electrostatic (longitudinal) waves, there can also exist electromagnetic (transverse) waves. The two sets of waves are generally coupled, but can nevertheless be classified as either mainly longitudinal or mainly transverse. It turns out that a plasma that is stable to longitudinal waves is unstable to transverse waves, unless the velocity distribution of its particles satisfies some rather stringent conditions. In a practical case these conditions require the distribution to be isotropic. (auth)

4192 LARGE-AMPLITUDE COMPRESSION WAVES IN AN ADIABATIC TWO-FLUID MODEL OF A COLLISION-FREE PLASMA. K. W. Morton (Courant Inst. of Mathematical Sciences, New York). J. Fluid Mech., 14: 369-84 (Nov. 1962).

The development of large-amplitude compression waves in a collision-free plasma is studied by considering the motion of a plane piston into a uniform stationary plasma containing a magnetic field parallel to the plane of the piston. The adiabatic two-fluid equations are solved by finite-difference methods and the form of the waves after a long time is compared with the possible steady-state solutions. A generalized discontinuous solution of the steady-state equations is found for sufficiently high Mach numbers. At the highest Mach numbers this leads to a constant state at the piston, while at lower speeds a wave train results whose amplitude increases as the speed decreases. In each of these cases the numerical solutions of the time-dependent equations converge rapidly to the steady-state solutions. At still lower speeds, where the solitary-wave solution exists, the situation is less clear. (auth)

4193 GAS-IONIZING SHOCK AND COMBUSTION WAVES IN MAGNETOGASDYNAMICS. J. B Helliwell (Royal Coll. of Science and Tech., Glasgow). J. Fluid Mech., 14: 405-19(Nov. 1962).

Some general properties of one-dimensional deflagration waves in a non-conducting inviscid gas at rest are discussed. Ionization of the gas is assumed to take place across a shock wave that precedes the flame front, and electromagnetic fields are allowed. The direction of wave propagation, electric field, and magnetic field are taken as a mutually orthogonal triad of vectors. The jump relationships across the gas-ionizing shock wave and magnetogasdynamic combustion wave are investigated and the two Hugoniot curves analyzed in detail in the pressure-specific volume plane. The possible types of wave are indicated for arbitrary magnitudes of the upstream electromagnetic field. It is shown that weak gas-ionizing shock waves cannot exist. For suitably chosen electromagnetic field strengths the density ratio across the shock wave may be greater than the ordinary gasdynamic limit and, in such cases, the pressure and density ratios are related in an inverse manner, in contrast to the behavior for ordinary gasdynamic or magnetogasdynamic shock waves. The magnetogasdynamic combustion wave has properties similar to those in ordinary gasdynamics. (auth)

4194 MICROWAVE RADIATION FROM A MAGNETO-PLASMA. Syoichi Miyoshi (Inst. of Physical and Chemical Research, Tokyo). J. Phys. Soc. Japan, 17: 1206-7(July 1962). (In English)

The electron density of plasma was measured by the interferometer method in the 8 mm wave region. Measurements of microwave radiation were carried out by using an 8.7 Bc/sec Dicke radiometer with 40 Mc/sec bandwidth and a sensitivity of 10^{-12} mw. The plasma was a section of the positive column of a d-c hot-cathode discharge in neon at 80 μ Hg pressure. A schematic diagram of the experimental setup and curves of the microwave power as a function of discharge current are shown. (W.D.M.)

4195 THE DESIGN AND CONSTRUCTION OF MAGNETIC FIELDS FOR PLASMA RESEARCH. Michal Cryzinski and Marek Sadowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nuclear Instr. & Methods, 16: 129-34(July 1962). (In English)

The main problems arising during the design and construction of medium size air-core electromagnets are discussed. The basic equations are given relating magnetic field strength, magnetic field rise time, power input, electrodynamic forces, and thermal conditions, e.g., allowable temperature rise to give the detailed dimensions required for the electrical conductor and the cooling annuli. The details for a 25 kgauss sectional oil-cooled electromagnet for plasma research are described. (auth)

4196 HIGH-ENERGY INJECTION FOR CONTROLLED FUSION. R. J. Mackin, Jr. and P. R. Bell (Oak Ridge National Lab., Tenn.). Nucleonics, 20: No. 11, 58-62(Nov. 1962).

High-energy injection is gaining impetus as a method of heating gas to extremely high temperatures. The principles of magnetic-mirror containment and losses by charge exchange are discussed. The various experiments in high-energy injection being operated or planned over the world are listed, and the design and operating experience of the machines are discussed in some detail. The main problems are the nature of the instabilities and how they can be stabilized. (D.L.C.)

4197 EXPERIMENTAL STUDY OF RAYLEIGH-TAYLOR INSTABILITY IN PLASMA. H. Dickinson, W. H. Bostick, J. N. DiMarco, and S. Koslov (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Fluids, 5: 1048-56(Sept. 1962).

A clear experimental observation of Rayleigh-Taylor, flute-type instability in a high-temperature plasma expanding across a magnetic field has been made with time-delay, Kerr cell, sequence photography. The wavelength and growth rate of the instability are measured as a function of time for various values of external magnetic field and background gas pressure. With interface decelerations of about 10^9 m/sec^2 the instability develops in 1-4 μsec with wavelengths of about 10^{-2} m. After 1-4 μsec the flutes grow with constant velocity. (auth)

4198 RAYLEIGH-TAYLOR INSTABILITIES OF A COLLAPSING CYLINDRICAL SHELL IN A MAGNETIC FIELD. E. G. Harris (Euratom-CNEN, Frascati, Italy). Phys. Fluids, 5: 1057-62(Sept. 1962).

The instability of a radially accelerated cylindrical shell in a magnetic field has been investigated. It was assumed that the shell was of infinitesimal thickness. For perturbations which do not bend the lines of the magnetic field, the growth rate was found to be $w = (gk)^{1/2}$, where g is the acceleration of the shell and k is the wavenumber. This growth rate is independent of the shell thickness. Perturbations which do bend the lines of the field were also found to be unstable. From a supplementary calculation, it was concluded that these instabilities were effective only for wavelengths greater than $8\pi a$ where 2a is the shell thickness. (auth)

4199 EQUILIBRIUM AND STABILITY OF HELICAL HYDROMAGNETIC SYSTEMS. John M. Greene, John L. Johnson, Martin D. Kruskal, and Lawrence Wilets (Princeton Univ., N. J.). Phys. Fluids, 5: 1063-9(Sept. 1962).

A formalism for representing helically invariant hydromagnetic systems is introduced. Such systems are the most general two-dimensional configurations in three-dimensional space, since they include translation-invariant and rotation-invariant configurations as special cases. Expressions for the magnetic field and, when the system is in equilibrium, the current are given in terms of an appropriate nonorthogonal coordinate system. An energy integral is given which forms the basis of a numerical relaxation procedure for obtaining equilibria. The relationship between this formalism and that in which the equilibrium problem is reduced to solving a partial differential equation for the stream function is established. The necessary and sufficient condition for the stability of helically invariant systems with respect to localized displacements is obtained. (auth)

4200 PLASMA BEHAVIOR IN A CUSP-MIRROR MAGNETIC FIELD. L. S. Combes, C. C. Gallagher, and M. A. Levine (Air Force Cambridge Research Lab., Bedford, Mass.). Phys. Fluids, 5: 1070-5(Sept. 1962).

A plasma containment device has been constructed in which an attempt has been made to combine the basic stability advantages of a four-pole line cusp with the low loss rate of a mirror field. The magnetic field was produced by the addition of the mirror field orthogonally to the cusp field. Using pulse techniques an ionized gas was created within a biconical chamber and a magnetic field produced transiently with the mirror field along the axis of the chamber (Z axis) and the cusp field in the X-Y plane. Measurements with magnetic probes and light pipes show that a disturbance in the magnetic field accompanied by an increase in light intensity started at the periphery of the plasma chamber and was propagated inward at two velocities to the central axis. Detailed measurements made on the magnetic-field configuration indicate that, at the time of arrival of the second wave at the axis, the mirror field had been to a large extent separated from the cusp field so that mostly mirror field existed throughout the central region, while mostly cusp field existed in the outer region. The intensity of the field at this time in the central region indicates that the cusp field was compressing the plasma and mirror field so that the intensities of the mirror field in this region were even larger than the maximum intensity of the applied mirror field. (auth)

4201 ONE-DIMENSIONAL PLASMA MODEL AT THERMODYNAMIC EQUILIBRIUM. O. C. Eldridge and M. Feix (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 5: 1076-80(Sept. 1962). (GA-2903)

The one-dimensional motion of a number of plane charged sheets is followed with an electronic computer. The energy in the electric field is computed for cases where the number of particles in a Debye length vary from $\frac{1}{4}$ to 10. These results agree with an exact theory given by Lenard. The Fourier components of the field energy and of the square of the current density are measured by averaging over a long time interval. These results are compared with values predicted by the linearized Vlasov equation. (auth)

4202 ADIABATIC ELECTRON FLUID IN THE PRESENCE OF STRONG SPACE-CHARGE FORCES. P. L. Auer (Sperry Rand Research Center, Sudbury, Mass.). Phys. Fluids, 5: 1091-4(Sept. 1962).

The case of an electron fluid with finite pressure embedded in a slowly varying axial magnetic field is treated. Allowing for the presence of ions and accompanying space-charge forces, it is found that variations in the resulting drift velocity v_D alter the electron's precession frequency from the gyrofrequency Ω to a new frequency ω, with $\omega^2 = \Omega^2 - \Omega \cdot (\nabla \times v_D)$. The precession orbit becomes distorted into an ellipse and the conventional adiabatic invariant is replaced with a new one. The fluid-dynamic consequences of these alterations are explored in the limit that the ini-

tial electron pressure is small compared to the initial magnetic pressure. (auth)

4203 ELECTROMAGNETIC RADIATION FROM AN ELECTRIC DIPOLE IN A COLD ANISOTROPIC PLASMA. Hans H. Kuehl (Univ. of Southern California, Los Angeles). Phys. Fluids, 5: 1095-1103(Sept. 1962).

The general solution to the problem of monochromatic radiation from an electric dipole in a magnetically biased, cold, tenuous plasma is presented. It is found that, generally, several waves exist in the radiation zone, traveling in different directions with different indices of refraction. For certain ranges of the plasma, gyro, and operating frequencies, the field becomes very large in certain directions compared with that in other directions, producing highly directive radiation characteristics. In general, the expression for the field is quite complicated although several special cases are treated which yield simple solutions. For high operating frequency it is found that the radiation pattern is identical to the isotropic case although a Faraday rotation takes place. Solutions are given for low and very low frequencies which place in evidence the guiding nature of the magnetostatic field. For the case of a large magnetostatic field it is shown that only two waves exist and that the time-average power flow is purely radial. (auth)

4204 WALL STABILIZATION EFFECTS IN THETA-PINCH CONFIGURATIONS. R. W. Kilb, H. Hurwitz, Jr., and W. F. Westendorp (General Electric Research Lab., Schenectady, N. Y.). Phys. Fluids, 5: 1131-3(Sept. 1962).

In attempting to understand the motion of plasma in a theta-pinch experiment, it is necessary to determine the magnetic field energy as a function of plasma position and shape. The results of theoretical calculations and an analog experiment aimed at accomplishing this objective are presented. The theoretical results pertain to perfectly diamagnetic plasmas of simple shapes, but the analog experiment can be extended to more complex situations. (W.D.M.)

4205 MICROWAVE SCATTERING FROM UNSTABLE PLASMA WAVES. William E. Drummond (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 5: 1133-4(Sept. 1962).

The scattering cross section from unstable plasma waves is proportional to the potential energy of the waves, and the cross section for scattering of microwaves from an incident propagation number, k_i, to a final propagation number, k_f, is proportional to $|E(K)|^2$, where $k_i + K = k_f$. The enhancement of this cross section, which results from even very weak instabilities, is estimated. (W.D.M.)

4206 ENHANCED DIFFUSION IN AN rf DISCHARGE IN THE PRESENCE OF A MAGNETIC FIELD. R. Geller (Stanford Univ., Calif.). Phys. Rev. Letters, 9: 248-51 (Sept. 15, 1962).

An experiment is described to show that anomalous diffusion seems to occur in plasmas, such as an r-f discharge, where a directed current does not exist. On increasing the static magnetic field, B, it was observed that one passes through a critical value, B_c, above which the flux of ions across the magnetic field no longer decreases but increases for a while. This anomalous rise in diffusion rate is generally accompanied by the commencement of r-f noise of an unknown origin. The product of B_c and the discharge tube diameter is roughly constant and B_c increases nonlinearly with pressure. It was also observed that the grid voltage of the r-f oscillator, V_g, reaches an extremum at nearly the same B_c at which the r-f noise commences. The external and internal ion saturation currents, j_{ext+} and j_{int+}, were measured, and j_{ext+}, j_{int+}, j_{ext+}, j_{int+}, and V_g are plotted as they vary with B. A second region of critical magnetic field strengths, $B_{c'}$, was also observed and is plotted. The values of B_c in hydrogen and argon are plotted for different pressures and different diameters of the discharge tube. (H.D.R.)

4207 SPECTROSCOPIC DETECTION OF THE ONSET OF PLASMA OSCILLATIONS IN A GAS DISCHARGE. A. Garscadden and E. M. Honor Gray (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 80: 640-7(Sept. 1, 1962).

Randomization of the energy and direction of an electron beam by interaction with a plasma often commences abruptly, with onset of electron oscillations, at a distance (D) of a few mm from where the beam enters the plasma. Measurements of D have been made in He, Ne, Ar, and Hg, as a function of pressure P, current I, beam voltage V, and oscillation frequency, from the positions of appearance of certain lines of He II, Ne II, Ar II, Hg II, and Hg III along the beam. Evidence has been found for limitation of the voltage amplitude of the electron oscillations by inelastic collisions with neutral gas atoms. D has been found to decrease with increase of $PIV^{\frac{1}{2}}$, and with increase in oscillation frequency. The experiments show that this form of oscillating discharge can probably exist in any gas at low pressure. (auth)

4208 RECOMBINATION BETWEEN ELECTRONS AND ATOMIC IONS. II. OPTICALLY THICK PLASMAS. D. R. Bates (Queen's Univ., Belfast), A. E. Kingston, and R. W. P. McWhirter. Proc. Roy. Soc. (London), Ser. A, 270: 155-67 (Nov. 13, 1962).

The effect of self-absorption on the rate of collisional-radiative recombination was investigated using a previously developed statistical theory. Detailed calculations were carried out on hydrogen ion plasmas. The following cases were treated: plasma optically thick towards lines of the Lyman series; plasma optically thick toward lines of all series; and plasma as in cases respectively but also optically thick toward the Lyman continuum. It was found that self-absorption may reduce the recombination coefficient considerably even in the low electron density limit. (auth)

4209 DEVICE FOR ACTING UPON A PLASMA JET. Wladimir v. Maydell (to Bolkow-Entwicklungen K. G.). German Patent DAS 1,122,182. "Application date Feb. 19, 1960."

A device is designed for generating a magnetic field to act upon a plasma jet. Part of the heat energy in the plasma jet is lost by thermal radiation. This radiation energy can be converted to thermoelectric power for generating the magnetic field. For the purpose of absorbing the otherwise dissipated radiation energy the plasma jet is surrounded by thermocouples connected either parallel or in series to form a solenoid. If the thermocouples have a low electric resistance, thermoelectric currents are generated. The magnetic field of these currents can be used to accelerate, focus, or deflect the plasma jet. (H.K.)

Shielding

Refer also to abstract 2743.

4210 (DASA-1318) ATTENUATION OF POINT SOURCE GAMMA RADIATION IN SLABS. Final Report. H. A. Mehlhorn, E. T. Clarke, R. Gold, and R. McMath (Technical Operations, Inc., Burlington, Mass.). Sept. 5, 1962. Contract DA-49-146-XZ-035. 82p. (TO-B-62-13)

Protection afforded by structures against gamma rays due to a nuclear explosion in the atmosphere is investigated, both theoretically and experimentally. Calculations are made for the differential dose-rate spectrum (in air)

due to fission products, and the differential dose spectrum to thermal neutron capture in nitrogen, as a function of distance from the explosion and time, extending for several minutes after the explosion. Integration of the spectra over photon energy and time show the accumulated air dose due to nitrogen capture to be far superior to that from fission products for several minutes at most distances. The superiority increases with distance and decreases with time. Some effects of nuclear weapon design on these conclusions are discussed. Data are reported for an experimental program providing measurements of attenuation of gamma rays in steel slabs, to compare with theoretical work being done at the National Bureau of Standards. Gamma rays from a cobalt-60 source, suspended in air, strike a steel slab at three angles of incidence. Transmitted radiation is detected by five ionization dose-rate meters at various distances below the slab. Information is given for 2-ft square slabs from $\frac{1}{4}$ to 2 in. thick, and detectors from 1 to 6 ft distant. It was found that slab-scattered radiation was approximately proportional to the solid angle subtended by the slab, that less radiation was transmitted at large polar angles of incidence, and that at least 2 in. of steel is needed to produce shielding improvement in a slab-covered hole. (auth)

4211 (UCRL-10440) TRANSPORT CALCULATIONS FOR PROTON SHIELDING. Gerald Litton, Rubin Goldstein, and Roger Wallace (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 26, 1962. Contract W-7405-eng-48. 7p.

The dose rate and integrated dose, inside a shield, due to an arbitrary proton flux was calculated. To this end, it was necessary to ascertain the effect of the shield on the incident flux. This aspect of the problem is considered. The analysis takes into account both proton ionization energy loss and secondary-particle production, using the transport method of successive generations. The secondaries considered are protons, neutrons, and π mesons. (auth)

4212 ACTIVE SHIELDING FOR MANNED SPACECRAFT. Sidney W. Kash and Robert F. Tooper (Armour Research Foundation, Chicago). Astronautics, 7: No. 9, 68-75(Sept. 1962).

Serious consideration is being given to the use of active shielding, in which an electrostatic or magnetic field set up in or about the space vehicle deflects charged particles away from its sensitive volumes. Once a field has been energized, no additional power is required to maintain it, except for the small power required to maintain the coils in a superconducting state. (W.D.M.)

4213 EFFECT OF BUILDING-UP FACTOR ON THE OPTIMUM SHAPE FOR A SHIELDING BARRIER. J. P. Jain and B. L. Sharma (Defence Science Lab., Delhi). J. Nucl. Energy Pt. A and B, 16: 375-6(July 1962).

A rod-shaped radioactive source or a long thin pipe containing radioactive material can be approximated as a line source. This type of source proves particularly feasible in the design of movable gamma facilities. The effect of the build-up factor in determining the optimum shape of the shielding barrier is discussed for a linear isotropic source. The effect of scattering in air is neglected in the calculations. (W.D.M.)

Theoretical Physics

4214 (UCRL-6657) EVALUATION OF THE QUANTUM MECHANICAL RING SUM WITH BOLTZMANN STATISTICS. Hugh E. DeWitt (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 16, 1961. Contract W-7405-eng-48. 35p.

A procedure is given for the evaluation of the quantum mechanical ring sum at finite temperature. The method is used for the evaluation of the quantum corrections to the classical Debye-Hückel free energy for an electron gas obeying Boltzmann statistics. The ring sum is shown to be of the form $(\beta e^2/\pi\lambda_D)P(\gamma)$ where $\gamma = \chi/\lambda_D$, $\chi = \hbar/(2mkT)^{1/2}$, and λ_D is the Debye screening length. The quantum effects for finite γ are due only to the operation of the uncertainty principle. The function $P(\gamma)$ decreases monotonically from the classical value $\pi/3$, and the form is shown to be: $P(\gamma) = (\pi/3)\,[1 + \Sigma_{n=2}\, a_n\gamma^{2(n-1)}]^{1/2} - \Sigma_{n=2}\, b_n\gamma^{2n-3}$. The coefficients a_n and b_n are evaluated exactly for small n and asymptotically for large n. The two series converge for $\gamma^2 < \gamma_c^2 = 2.042\cdots$. For $\gamma^2 > \gamma_c^2$ there is indication of some kind of phase transition. The function $P(\gamma)$ is also evaluated in the limit of very large γ, and it is shown that the low-temperature, free-energy contribution from the ring sum for distinguishable electrons is of the order of $(kT)^{1/2}$. (auth)

4215 RETARDED FUNCTIONS AND POTENTIAL SCATTERING. G. Berendt (Freie Universität, Berlin). Nuovo cimento (10), 23: Suppl., No. 2, 309-19(1962). (In English)

Starting with an equation for retarded functions it is possible to construct solutions for the scattering amplitude from certain given boundary values of the retarded functions. The calculation of these solutions may be performed by means of the N/D-method or by using a procedure recently developed by Omnes. (W.D.M.)

4216 ANALYTIC WAVE FUNCTIONS. IV. INCLUSION OF CORRELATION. R. G. Breene, Jr. (General Electric Co., Philadelphia). Phys. Rev., 128: 2190-4 (Dec. 1, 1962).

A general method was developed for including correlation of the 2p electrons in atomic wave function programs. In introducing correlation, an appeal has been made to the interelectronic coordinate method of doing so. Tables are given which enable one to write down the 2p correlated energy expression rapidly in terms of the radial integrals for any atoms having 2p electrons of the same magnetic quantum number. One then solves for the correlation parameter a, and the result follows. In the case of an atom or atomic state treated for the first time, this entire procedure would take place after the programs had been applied to the obtention of the effective nuclear charges. Only the 2p electrons have been considered by virtue of their importance to atomic interactions with exterior particles. Oxygen in its ^3P ground state was studied. Previously 2018.28 ev had been obtained for the total energy. Now 2039.81 ev was obtained. The experimental value is 2043.3. (auth)

4217 IMPULSE APPROXIMATION. Johan G. Belinfante (California Inst. of Tech., Pasadena). Phys. Rev., 128: 2403-6(Dec. 1, 1962).

The impulse approximation is discussed and simple applications are made to two problems of current interest, the determination of the ωNN coupling constant and the Regge pole predictions for high-energy scattering. (auth)

4218 EXTENSION OF THE FOLDY-WOUTHUYSEN TRANSFORMATION. E. I. Blont (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 128: 2454-8(Dec. 1, 1962).

By use of Moyal's representation and a perturbation theory developed by the author, the interband matrix elements of the Dirac Hamiltonian in the presence of external fields are removed. The result is exact in terms of velocity, but appears as a series in the field strengths and their derivatives, which is evaluated to second order in the fields and first order in their first derivatives. (auth)

4219 COMPLEX ANGULAR MOMENTA AND UNITARITY IN CROSSED CHANNELS. J. C. Polkinghorne (Univ. of California, Berkeley). Phys. Rev., 128: 2459-61(Dec. 1, 1962). (UCRL-10353)

Regge poles are assumed to exist and the further singularities in the Regge plane resulting from the effect of the separate terms in the unitary sum in the crossed channels are investigated. Three families of singularities are found. However, the equations of the singular curves are independent of the number of particles in the intermediate state corresponding to the term in the unitary sum being considered. Consequently, no firm conclusion can be made about the behavior of the complete amplitude, owing to the possibility of cancellations. (auth)

4220 CLASSICAL RADIATION RECOIL. Asher Peres (Syracuse Univ., N. Y.). Phys. Rev., 128: 2471-75(Dec. 1, 1962).

The conditions under which a material system may recoil while emitting electromagnetic or gravitational radiation are investigated. The lowest order secular effects in the electromagnetic case arise from an interference of the electric dipole radiation with the electric quadrupole or magnetic dipole radiations. In the gravitational case, the lowest order terms involve the interference of the mass quadrupole radiation with the mass octopole or the flow quadrupole radiations. The investigation of the gravitational radiation recoil is carried out in complete analogy with the more elementary electromagnetic case, so that this paper should be accessible to physicists having no previous knowledge of general relativity theory. (auth)

4221 TWO-COMPONENT FIRST-ORDER WAVE EQUATIONS. P. Sen (National Physical Lab., New Delhi, India). Phys. Rev., 128: 2476-?(Dec. 1, 1962).

It is shown that a suitable definition of the dotted spinors in terms of the undotted spinors allows the linearization of the two-component second order Feynman Gell-Mann wave equations. The linearized two-component first-order wave equations are similar to the original Jehle wave equations. They are covariant with respect to the restricted Lorentz group and are transformed into their complex conjugate wave equations by a reflection. Then it is shown that the current vector derived from them is a world vector. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 3113, 3212, 3543, 3700, 3701, 3715, 3719, 3735, 3736, 3738, 3739, 3740, 3741, 3743, 3744, 3745, 3746, 3749, 3751, 3752, 3753, 3754, 3755, 3756, 3758, 3760, 3761, 3766, 3767, 3768, 3769, 3770, 3773, 3781, 3786, 3793, 3813, 3819, 3822, 3823, 3824, 3825, and 3845.

4222 (ANL-6635) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, OCTOBER 1962. (Argonne National Lab., Ill.). Nov. 15, 1962. Contract W-31-109-eng-38. 65p.

Technical progress in specific reactor projects and in general engineering research and development is reported. The information is presented in five main sections for each of which a separate abstract was prepared. (J.R.D.)

4223 (ANL-6635(p.1-7)) WATER-COOLED REACTORS. (Argonne National Lab., Ill.).

Additions and modifications to the EBWR plant are reported which permit heat dissipation at power levels up to 100 Mwt. The plant is authorized to operate at its full capacity, and operational testing at approximately 85 Mwt was reached. Operations and experiments concerning the Borax-V are also reported. Details of modification and maintenance are reported along with analysis of a Borax-V dynamic model, corrosion tests of 304 stainless steel in steam, fabrication of cermet fuel elements, and flowmeter calibration. (J.R.D.)

4224 (ANL-6635(p.8-27)) LIQUID METAL-COOLED REACTORS. (Argonne National Lab., Ill.).

Experiments were conducted with ZPR-III assembly 41 which consists of 20% enriched U diluted in metal. Data on central fission ratios and sample-size effects in measurements of central- and radial edge-reactivity coefficients are presented. Other experiments are reported on blankets and reflectors and a rotary control rod mockup containing boron carbide in the radial blanket. In developmental work on the ZPR-VI and -IX, installation of the control wiring for the reactor-cell air conditioning and installation of the Ar storage system were completed. A summary of foil irradiation activities is included. Developmental programs concerning EBR-I, EBR-II, and FARET are summarized. (J.R.D.)

4225 (ANL-6635(p.28-50)) GENERAL REACTOR TECHNOLOGY. (Argonne National Lab., Ill.).

Activities in applied reactor physics are reported on fast neutron spectrum measurements, high-conversion critical experiment in ZPR-VII, absolute measurement of neutrons per fission in U^{235} and Cf^{252}, elastic scattering of neutrons, and theoretical physics. Activities devoted to fuels and materials development were directed toward corrosion of Nb by Na and Ti corrosion by Hg, ceramic fuel properties, and nondestructive testing. Other work is reported in heat engineering and chemical separations including fluidization and volatility processes, and chemical-metallurgical processes. (J.R.D.)

4226 (ANL-6635(p.51-4)) ADVANCED SYSTEMS RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

Developmental work on the Argonne Advanced Research Reactor was devoted to site and buildings and core research including physics calculations, critical experiments, hazards analyses, and hydraulics studies. A parametric study of the maximum power/weight ratio for small pressurized water systems for undersea applications is in progress. (J.R.D.)

4227 (ANL-6635(p.55-9)) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

Safety investigations are reported concerning metal oxidation and ignition and metal-water reactions. Other studies were conducted on fast reactors in meltdown experiments with uranium oxide and uranium sulfide specimens. Also reported are integral Na loop development activities and operation and maintenance of TREAT. (J.R.D.)

4228 (CEA-2193) LE RÉACTEUR RAPIDE SURRÉGÉNÉRATEUR RAPSODIE. VOLUME 1: TEXTE. VOLUME 2: FIGURES. (The Fast Breeder Reactor Rapsodie. Volume 1: Text. Volume 2: Figures). C. P. Zaleski and L. Vautrey (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Cadarache). 1962. 204p.

A description of the RAPSODIE Project is presented. Information is included concerning the principal neutronic and thermal characteristics of the reactor, cooling circuit design, handling devices, control system design, and functions of the facility buildings. The reactor is expected to be critical by 1964. (J.R.D.)

4229 (CRRP-1116) THE THEORY OF THERMAL NEUTRON DIFFUSION IN A REACTOR LATTICE. J. D. Stewart (Atomic Energy of Canada Ltd., Chalk River, Ont.). Oct. 1962. 97p. (AECL-1637)

Work was carried out to give a clear and reasonable definition of the thermal-diffusion area L^2 of a lattice-type thermal neutron reactor and to give a method for calculating L^2. A general discussion of neutron migration in a lattice is presented. It includes a definition of L^2, i.e., $L^2 \equiv M^2 - L_1^2$; M^2 is the migration area, whose definition is as straightforward for a lattice as for a homogeneous medium, and L_1^2 is the slowing-down area or age calculated in the usual way. A working definition of L^2 was introduced by approximating the spatial slowing-down distribution by a step function. It is shown that the working definition leads to the familiar $L^2 = \sum_i f_i L_i^2$ under certain circumstances. Methods of calculating L^2 in the general case are discussed. The fraction of the thermal neutrons born in one cell that will escape and be captured in the outside lattice, and the lattice relaxation length of these escaping neutrons must be calculated. These two quantities are calculated approximately by matching fluxes and currents at cell interfaces, and the accuracy is increased by a comparison with a homogeneous medium of the same relaxation length. The method was tested by using the microscopic-discrete theory. (auth)

4230 (DL-51) CRITERIA FOR THE SELECTION OF MATERIALS FOR WATER-COOLED REACTORS, WITH COMMENTS ON D_2O REACTORS. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 6, 1962. 21p. (AECL-1567)

When intense radiation, high temperatures, and high mechanical stresses act in combination on different materials in contact, the familiar classification of materials into solids, liquids, and gases is a handicap rather than a help. Water becomes a source of H_2 that will pass into a metal and change its resistance to stress. Hydrogen dif-

fuses rapidly through metals even at water temperatures. At the higher temperatures in nuclear fuel, O_2 and C diffuse rapidly. In some ceramic fuels the operating temperatures are so high that even heavy atoms will dwell less than a msec in any given lattice position. With so high a rate of the breaking of bonds, diffusion and interaction, the contribution of all substances present to the general ecology needs consideration. The stabilization of the mechanical properties of metals when bombarded by fast neutrons and exposed to wandering atoms, especially H, has to be studied. The behavior of Zr alloys and UO_2 in such environments has been extensively studied, and useful design criteria have been set and explored. (auth)

4231 (DP-758) EXPONENTIAL MEASUREMENTS ON 19-ROD CLUSTERS OF UO_2 RODS IN D_2O. Norman P. Baumann (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1962. Contract AT(07-2)-1. 33p.

Buckling measurements were made in the Savannah River Laboratory Exponential facilities on D_2O-moderated, 19-rod clusters of natural uranium oxide rods. Four triangular lattice pitches from 7.00 to 12.12 inches and a single square pitch of 8.00 pinches were used. Measurements were made at room temperature and at selected temperatures up to 218°C. Buckling changes resulting from voids inside housing tubes that surrounded the clusters were also measured. Intercomparisons of the results with critical void coefficient measurements demonstrated the validity of calculations for the anisotropic diffusion effects of the voided lattices. Foil activation measurements of the lattice parameters f, L^2, p, and ϵ were made for representative lattices. The experimental results are compared with calculations. (auth)

4232 (DP-778) APPLICATION OF ACTIVATED CARBON IN REACTOR CONTAINMENT. George H. Prigge (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1962. Contract AT(07-2)-1. 56p.

An activated-carbon bed, or filter, was designed to remove 99.9+% of the radioactive halogen vapor that could be released as the result of a containable accident of a water-moderated-and-cooled reactor. The filter was intended for installation in the exhaust of the ventilation system of the reactor building and was designed on the basis of results from tests of small-scale filters that mocked up a section of a 1-inch-thick carbon bed of a full-size filter. The tests showed that the iodine adsorption efficiency of the design was consistently 99.99+% when exposed to air, nearly dry steam, and mixtures of steam, air, and entrained liquid water particles. The tests simulated conditions of normal exposure of the carbon filters to the air in the ventilation exhaust as well as to exposure conditions postulated for a containable reactor accident. (auth)

4233 (GA-2301) DEVELOPMENT OF CARBON-COATING PROCESS FOR $(Th,U)C_2$ FUEL PARTICLES. Glen B. Engle (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Oct. 10, 1961. Contract AT (04-3)-314. 53p.

The major portion of the development work deals with the carbon-coating process and the evaluation of coating material and coated particles. A brief characterization of the quality and types of bare-carbide base stock is also given. It should be recognized that during the early experiments $(Th,U)C_2$ particles were difficult to obtain with any degree of regularity or uniformity of quality; therefore, a variety of particles was used. For subsequent studies relatively large amounts of melted carbide particles were available. (auth)

4234 (HW-48861TH) DETERMINATION OF TIME-DISPLACEMENT CURVES FOR VERTICAL SAFETY RODS (thesis). Gentry Everett Wade (Idaho. Univ., Moscow and General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1, 1957. Contract AT(45-1)-1350. 88p.

An analytical determination was made of the time-displacement curves for air-operated vertical safety rods. Various vertical safety rod design parameters such as accumulator volume, accumulator pressure, length of rod travel, rod weight, cylinder diameter, cylinder port location, cylinder port size, relief valve size, and relief valve setting can be varied to get the desired time displacement curves. Results of experimental tests are included which verify the theoretical determinations. A sample solution for a typical vertical safety rod design problem is included. (auth)

4235 (HW-71521) MEASUREMENT OF CYLINDRICAL SHAPES. Kenneth R. Merckx (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1961. Contract [AT(45-1)-1350]. 17p.

A method of cylindrical coordinates is used to define the surface geometry of distorted tubular reactor fuels. Seventy-two circumferential readings are taken at each of ten axial stations. (R.J.S.)

4236 (HW-73013) ENGINEERING REVIEW—PRTR FUEL FAILURE DETECTION AND LOCATION SYSTEM (FFDLS). H. K. Nelson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 19, 1962. Contract AT(45-1)-1350. 32p.

A description of the FFDLS as it currently exists and a review of the bases on which it was chosen are presented. A history of tests performed on the system and significant results obtained are included. Recommendations are also included concerning equipment modification which should result in a workable detection system. (J.R.D.)

4237 (HW-74287) HEAD-WELDED SWAGEABLE END CAP FOR UO_2–PuO_2 FUEL ELEMENTS. L. C. Lemon and W. T. Ross (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1962. Contract AT(45-1)-1350. 15p.

A head-welded swageable end cap of Zircaloy-2 was developed and adopted for use on swage-compacted UO_2–PuO_2 fuel elements for the Plutonium Recycle Test Reactor. A tungsten-arc, inert-gas, circumferential head weld is made in a static helium atmosphere using a direct current, rectifier-type welding machine. Destructive tests resulted in failures in the fuel cladding material with no failures occurring at the weld. Seven-rod clusters with swageable end caps were irradiated successfully in the ETR and 19-rod clusters are being irradiated in the PRTR. (auth)

4238 (IDO-16799) ANNUAL PROGRESS REPORT ON FUEL ELEMENT DEVELOPMENT FOR FY 1962. G. W. Gibson and W. C. Francis (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Aug. 15, 1962. Contract AT(10-1)-205. 127p.

Activities in a project aimed at the improvement of fuel elements for high flux test reactors are reported. The investigation of new fuel compositions, distributions, and geometries is being undertaken to increase fuel life, to improve the flux distribution, and to provide a means of safely reaching higher reactor operating power and power density in these reactors. The effects of nuclear irradiation on the fuel and structural materials is being studied to predict the performance of these materials in more advanced reactor designs. A summary of the past year's progress is given and the fabrication and irradiation of

samples containing up to 50 wt % U–Al alloys, cermets of UO_2, U_3O_8, UC, UN, U_3Si, and Al, clad in various Al and Be–Al materials is described. The use of ThO_2 and Th cores, the addition of BeO to cermet cores and high density fuel cores of U–Al intermetallics produced by powder metallurgy techniques were studied during the year. High strength APM claddings involving Al_2O_3 contents from 6 to 10% were tested and indicate the need for improved quality control of the APM material. Duplex claddings involving burnable poison layers and APM clad with corrosion resistant X8001 showed promise where special properties are desired. The results of the work continue to demonstrate the excellent radiation stability of U–Al fuels even after long irradiation exposure at elevated temperatures. Tests up to 350°F and after 50% burnup of the U^{235} in U–Al alloys, show no appreciable dimensional or microstructure changes. UO_2 and U_3O_8 react with Al under radiation to form UAl_4. Tensile tests of these fuels at ambient temperatures show appreciable loss in ductility with irradiation; several compositions actually exhibiting zero ductility. Irradiation at temperatures up to 200°F of cold-worked and of heat-treated Al does not destroy the pre-irradiation hardness and strength of these materials. Computer optimization of fuel element geometries from the standpoint of heat transfer, hydraulics, and strength resulted in the design and fabrication of a 32-plate fuel element. Hydraulic tests produced favorable results and the element is ready for MTR testing. Future work stressing materials development will be directed toward extending U–Al fuels to use at 400 to 800°F. Continued studies on graded fuels, Be damage, and the Th–U^{233} system are also planned. Tensile testing will be extended to higher temperatures in pre- and post-irradiation measurements and the study of the effect on cold worked and tempered materials of elevated temperature-radiation exposures will be continued. (auth)

4239 (JPL-TR-32-188) FISSION-FRAGMENT ENERGY LOSS FROM VORTEX TUBES. Henry J. Stumpf (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 12, 1962. Contract NAS 7-100. 14p. (AD-274313)

The heat load in the solid regions of the vortex-tube reactor due to fission fragments reaching the tube walls was calculated according to a simplified model. Within the limits of the analysis, it can be seen that this heat load is reduced to a few percent of the total power if the diameter of the vortex tubes is greater than 20 cm at an exhaust pressure of 100 atm and greater than 8 cm at 300 atm. As the tube diameter is increased beyond these values, the effect on the fission-fragment heat load is small, and the dependence upon the specific impulse ratio and the ratio of fuel to propellant density becomes insignificant. (auth)

4240 (KAPL-M-EC-26) SRS—SCRAM ROD DRIVE MECHANISM PROGRAM. D. L. Briggs and J. R. Schmid (Knolls Atomic Power Lab., Schenectady, N. Y.). Oct. 1, 1962. Contract W-31-109-eng-52. 21p.

SRS is a digital computer program which solves a nonlinear second order differential equation. The program is particularly oriented toward solving the equation which results from applying Newton's Law to a control rod. With a re-definition of the constants SRS could be used to solve any equation of the same form. Input to the program consists of initial data, coefficients and control constants. The output consists of time increment, displacement, velocity, and acceleration. The numerical integration is performed through use of the Adams-Moulton Shell Integration method (The AMSINT subroutine), with provision for overriding any singularities which might occur. The approximate running time is 0.015 hours per case. (auth)

4241 (LS-118) HEAVY WATER REACTORS. Bibliography. B. Gilbert, comp. (Israel. Atomic Energy Commission, Rehovoth). June 1962. 331p.

A bibliography on heavy water reactors in operation, under construction, or definitely committed for construction is presented covering the period January 1948 to December 1961. The 994 references are arranged under the following topics: heavy water reactors (general), CANDU, CVTR, EL-4, NPD, OCDRE, R-3 ADAM, SDR, HBWR, Aquilon Pile, DMTR, HWCTR, Mighty Mouse, NRU, NRX, PRPR, PRTR, TBR, ZEEP, Zero Energy Reactor (RB), Argonne (CP) Reactors, BBRR, CIR, DIORIT, FR-2, DIDO, PLUTO, HIFAR, ISPRA, JRR-3, MITR, EL-2, EL-3, ECNG-FWCNG (Florida), JEEP, R-1 (Swedish HWR), and ZOE. An author index is included. (M.C.G.)

4242 (NAA-SR-7400) ANNUAL TECHNICAL PROGRESS REPORT, AEC UNCLASSIFIED PROGRAMS, FISCAL YEAR 1962. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 15, 1962. Contract AT(11-1)-Gen-8. 476p.

Research and development progress is reported in 7 sections. Separate abstracts were prepared for each section. (J.R.D.)

4243 (NAA-SR-7400(Sect.I)) ADVANCED SODIUM COOLED REACTORS. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 127p.

Details concerning operation and development of the Sodium Reactor Experiment are presented. Other information is included on critical experiments, development of reactor materials and components, development of ceramic and alloy fuel elements, and reactor safety investigation in the areas of two-phase forced Na convection and fission product release from Na fires. (J.R.D.)

4244 (NAA-SR-7400(Sect.II)) HALLAM NUCLEAR POWER FACILITY RESEARCH AND DEVELOPMENT. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 25p.

Research and development progress is reported on reactor facility engineering, hydraulic component studies, lattice studies, UC fuel development, and U alloy fuel evaluation and fabrication. (J.R.D.)

4245 (NAA-SR-7400(Sect.III)) ADVANCED ORGANIC MODERATED REACTOR. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 138p.

Research and development progress on organic-moderated reactor experiment is reported along with developmental work on advanced OMR concepts, organic cooled technology, and fuels for use in organic coolants. (J.R.D.)

4246 (NAA-SR-7400(Sect.IV)) PROTOTYPE ORGANIC POWER REACTOR. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 40p.

Activities in a program to develop process and quality procedures for fabrication of proposed fuel element designs for the 50-Mw Prototype Organic Power Reactor (POPR), and for development of fabrication specifications for the first 50-Mw POPR core are reported. The primary fuel system for development is UO_2 clad in APM Al alloy. Alternate fuel cladding materials are also being considered. (J.R.D.)

4247 (NAA-SR-7400(Sect.V)) REACTOR SAFETY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 43p.

Activities in a program to determine adequate design

requirements for construction of low-leakage reactor housing installations using conventional building materials are reported. Progress is reported in other programs such as fission product retention in reactor coolants, void formation in organic reactor transients, pressure transients and flow stability, reactor safety, measurement of Doppler coefficients, and safety of Aqueous Homogeneous Research Reactor. (J.R.D.)

4248 (NAA-SR-7400(Sect.VI)) SEPARATIONS CHEMISTRY. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 18p.

Activities in a program to develop methods for reprocessing of refractory U fuels are reported. Other information is included on bench-scale reprocessing of reactor-irradiated fuels and development of new reprocessing methods. (J.R.D.)

4249 (NAA-SR-7400(Sect.VII)) ADVANCED DEVELOPMENT PROGRAM. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). 99p.

Progress is reported in research on reactor physics, fuel elements, fission effects in metallic fuels, irradiation techniques, structure and properties of U carbides, properties of BeO, high-temperature behavior of metal-salt systems, radiation chemistry, properties of fused oxides and glasses, structure of metals, defect controlled processes in metals, and radiation damage in crystalline solids. (J.R.D.)

4250 (NYO-10095) EVALUATION OF AUTOMATIC FLOW BALANCING DEVICE IN BOILING WATER REACTORS. Quarterly Progress Report, August–November 1962. Report 344. R. L. Mela, D. A. Gall, E. F. Doyle, and N. A. Radovcich (Dynatech Corp., Cambridge, Mass.). Nov. 1962. Contract AT(30-1)-2907. 24p.

Activities in a program to design and evaluate an automatic flow balancing device for boiling reactors are reported. The device being studied is designed to maintain the exit steam quality uniformly over all the reactor channels throughout the reactor's operating time. Data obtained on two-phase venture and flow control systems are reported. Design objectives were achieved in over-all operation of the flow control system. (J.R.D.)

4251 (ORNL-TM-218) DEVELOPMENT OF REGENERATIVE COMPRESSOR FOR HELIUM CIRCULATION. I. K. Namba (Oak Ridge National Lab., Tenn.). July 20, 1962. Contract [W-7405-eng-26]. 21p.

Compressors were required to circulate helium coolant in an in-pile loop at moderately high heads (6000–8000 ft), at low volumetric flows (30–40 acfm), at 600°F and 385 psig. A regenerative type of gas compressor, using grease-lubricated ball bearings enclosed in a special water-cooled casing, was designed and tested. The design objectives were achieved, and a number of these compressors have been built and are in operation. (auth)

4252 (ORNL-TM-397) TIME-DEPENDENT RELEASE OF GASEOUS MATERIAL FROM A THREE-BARRIER REACTOR CONTAINMENT SYSTEM. Truman D. Anderson (Oak Ridge National Lab., Tenn.). Nov. 16, 1962. Contract W-7405-eng-26. 26p.

The problem of time-dependent release of gaseous activity from a three-barrier containment system is formulated. The three-barrier model is made up of the reactor core and two containment structures all in series. Analytical solutions are obtained of the release rate to the atmosphere for two special cases. A graphical solution is given for the special case of step release from the reactor core; examples are given to illustrate the use of the graphical solution. (auth)

4253 (PRDC-TR-58) MONTHLY TECHNICAL REPORT [ON APDA ACTIVITIES] APRIL 1962. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 19p.

Developmental activities are reported concerning fuels and metallurgy, chemistry and materials, primary shield tank atmosphere requirements, physical-chemical data on boron compounds, engineering analysis, graphite, physics, reactor systems, and electrical and instrument systems. (J.R.D.)

4254 (TID-17292) EXPERIMENTAL AND ANALYTICAL RESULTS FOR A ZIRCONIUM–URANIUM UNPOISONED CRITICAL SLAB ASSEMBLY. James R. Tomonto (Knolls Atomic Power Lab., Schenectady, N. Y.). [Sept. 20, 1962]. Contract [W-31-109-eng-52]. 10p.

Reactivity coefficients, criticality data, and flux distributions were measured in the Plastic Mockup Assembly for an unpoisoned, slab reactor. The core was constructed in two sections, one stationary and the other on an elevator platform. The fuel was 20 wt % uranium enriched to 93% U^{235} in a zirconium matrix plate. Reactivity coefficients were measured on both a position dependent and core distributed basis. The reactivity change associated with a particular material substitution was evaluated by means of doubling time measurements and were in the range from 10 to 20¢. The results were tested with two cross-section schemes. (M.C.G.)

4255 (UCRL-6329) SUMMARY REPORT ON A HIGH-TEMPERATURE BERYLLIUM-OXIDE CRITICAL EXPERIMENT. R. Finke, E. Goldberg, H. Reynolds, and G. Grammens (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 21, 1961. Contract W-7405-eng-48. 36p.

An experimental verification of multigroup calculations of critical dimensions as a function of temperature of a beryllium-oxide-moderated, enriched-uranium-fueled assembly was made using Hot Box, a high-temperature critical facility. A decrease in buckling of 2.5% was required to compensate for an increase in core temperature from 90 to 955°F for a bare equivalent core with an effective BeO density of 2.86 g/cm^3 and a gross BeO/U^{235} molar ratio of about 550 to 1. The reactivity change was within 5% of the change predicted by the Zoom multigroup, multiregion, one-dimensional diffusion code for an equivalent core configuration. An overall average temperature coefficient of reactivity of –$0.48/100°F was measured for the temperature range studied, and a nuclear temperature coefficient of –$0.34/100°F was deduced. (auth)

4256 (UCRL-7127) DISCUSSION OF ASME PAPER 62-WA-218: "STUDY OF REACTOR KINETICS." A. B. Miller (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1, 1962. Contract W-7405-eng-48. 11p.

The author of 62-WA-218 is commended for original work in developing a mathematical model of reactor kinetics phenomena involving mechanical inertia effects. A direct mechanical analog of the author's mathematical model is described as well as an equivalent closed loop feedback circuit. (auth)

4257 (UNC-Memo-5039) PRELIMINARY STUDY OF POWER EXCURSIONS FOR POTENTIALLY UNSTABLE REACTORS. L. Wills (United Nuclear Corp. Development Div., White Plains, N. Y.). Sept. 30, 1962. Contract AT(30-1)-2832. 24p.

The simultaneous nonlinear differential equations describing the power in a reactor having a prompt positive reactivity coefficient and a delayed negative feedback related to heat conduction are integrated numerically for a

limited range of reactor parameters. The calculations show that while such a reactor may be unstable above a certain threshold power, it may undergo a power excursion of limited extent and duration when subjected to a step insertion of reactivity while operating at a sufficiently low power. Stability criteria are examined and, in certain cases, related to the linearized form of the equations. (auth)

4258 NEUTRON FLUX FLATTENING IN THERMAL REACTORS. Ragnar Liljeblad. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 99-110(1962). (In English)

The possibilities of achieving radial neutron flux flattening in nuclear reactors are discussed. It is shown that in larger reactors a considerable neutron flux flattening is possible without the mean burn-up of the fuel being reduced to any great degree. With smaller reactors, however, the neutron flux flattening will be economically meaningless. The local neutron-flux variations resulting from the mixing of fuel elements having a varying degree of burn-up cannot be suitably eliminated by means of grey control rods. (auth)

4259 BURN-UP OF COMPOSITE CONTROL-ROD MATERIALS IN A NUCLEAR REACTOR. Jan Erik Lunde. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 111-28(1962). (In English)

A method was developed for calculating the burn-up of a composite control-rod material and giving the number of the different absorbing isotope atoms per volume unit as a function of space co-ordinate and irradiation. It is thus possible to gain an understanding of the amount of irradiation that a control rod can withstand without losing its reactivity-controlling ability. Some simplifying assumptions are introduced, the main one being equivalent to an incoming neutron current consisting of monoenergetic neutrons. Various numerical results are presented. The absorber material consists of Ag–In–Cd alloys and boron steel. The effect of the burn-up upon the reactivity controlled by a central control rod in the R3/Adam nuclear power plant is given and the different absorber materials are compared. (auth)

4260 INVESTIGATIONS ON PWR PUMP-FAILURE ACCIDENTS. THE INFLUENCE OF A REDUCTION IN THE COOLANT FLOW ON THE SAFETY ASPECTS FOR A D_2O-MODERATED AND D_2O-COOLED PRESSURIZED-WATER REACTOR. Terje A. Granberg. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 189-202 (1962). (In English)

The consequences of an increase in power and temperature resulting from a failure in the supply voltage to the motors driving the main circulation pumps of a pressurized-water reactor were investigated. This study covered varying forms of reduction of the coolant flow, as well as the influence of the magnitude of this reduction and the retardation time. Relationships are presented for the new steady-state coolant temperature after a reduction in the coolant flow, and for the dependence of the temperature increase on the retardation time. On the basis of these relationships, it is possible to select the safety alternatives that can be best adapted to the safety requirements of the system. An actual stand-by power system is also described. (auth)

4261 A NEW XENON PREDICTOR FOR HIGH-FLUX REACTORS. Olov Rydén and Carl-Axel Bergqvist. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 203-10(1962). (In English)

The well-known equations for the production and decay of iodine and xenon-135 are utilized for predicting the variation of xenon poisoning in a nuclear reactor. These equations can be easily represented in an electrical analogue circuit, provided that the initial values of I and Xe are known. A xenon predictor designed in this manner can be modified so as to simulate the xenon poisoning in a reactor. The values of I and Xe are calculated at intervals on the basis of the reactor flux. It is assumed that the reactor flux is approximated to a constant value between the measurements. In the most unfavorable case, this step-by-step method will result in an amplitude error of max. 10 per cent of the equilibrium value of the xenon poisoning. (auth)

4262 FORECASTING COST TRENDS FOR NUCLEAR PLANT MAINTENANCE. C. Patrick Cabell (General Electric Co., Richland, Wash.). Atomics, 15: No. 4, 8; 11(Oct., Nov., Dec. 1962).

A mathematical method for calculating reactor maintenance cost trends is presented, based on operating and maintenance costs for the Hanford reactors. (auth)

4263 RESONANCE INTEGRAL OF FUEL CLUSTERS. H. Schludi. Atomkernenergie, 7: 312-18(Sept. 1962). (In German)

Fuel clusters can be considered either as a homogeneous or as a heterogeneous assembly of single fuel rods. An experimentally found working formula is given which allows the resonance integral to be calculated according to the homogeneous treatment. It is explained how the resonance integral of a fuel cluster can be calculated if one knows the self-shielding effect of two single fuel rods. (auth)

4264 THERMAL NEUTRON DENSITY DISTRIBUTION IN CHANNELS OF HEAVY WATER REACTOR MODEL WITH ROD-TYPE FUEL ELEMENTS. V. F. Bělkin and O. V. Shvedow. Jaderná Energie, 8: 343-8 (1962). (In Czech)

Experimental values of thermal neutron density distribution in two types of channels in a heavy-water reactor model (mock-up) with rod-type fuel elements are reported. Formulas were derived to enable the calculation of thermal neutron flux density distribution for unperturbed core lattice, the density distribution in channels around cadmium control rods, and in channels with free (empty) channel (without uranium) in the neighborhood. (auth)

4265 AN ANALYSIS OF DYNAMIC CHARACTERISTICS OF PLUTONIUM- AND/OR THORIUM-RECYCLED REACTOR. III. ANALOG COMPUTER APPLICATION. Itaru Michiyoshi and Kunihiko Uematsu. Nippon Genshiryoku Gakkaishi, 4: 671-6(Oct. 1962). (In English)

The analog reactor simulator is used to analyze the dynamic characteristics of a reference reactor which is assumed to have heat removal characteristics of constant power removal for both cases of Pu recycle and non-Pu recycle. The Pu recycled reactor which has the shorter effective neutron life time and the smaller effective delayed neutron fraction reaches a higher maximum power than that of the non-plutonium recycled reactor during the stable power excursion. However, the maximum temperature rise of the reactor materials does not much differ between the cases. Judging the dynamic characteristics of the reactor from the point of view of the maximum temperature of the reactor materials, the Pu recycled reactor has no less favorable character than the non-Pu recycled reactor despite of its higher maximum power rise. (auth)

4266 HYDRAULIC INSTABILITY IN A FORCED CIRCULATION LOOP OF PARALLEL CHANNELS. Hiroshi

Muto (Japan Atomic Industry Forum, Inc., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 693-9(Oct. 1962). (In Japanese)

Oscillations have been reported principally at lower pressures with boiling in the channel. It is clear that BWR operation under these conditions is somewhat uncertain and that a procedure for determining the conditions at which these oscillations occur would be useful. The inlet flow of one of the parallel channels is related to the heat flux in that channel for small transient in power. This result has been obtained by examining the effect of a small flux disturbance on the inlet flow. The change of density with enthalpy, $\partial\rho/\partial h$, is very variable in a two-phase region. This region which has a steep density-enthalpy gradient represents an unstable condition, giving the hydrodynamic flow pattern of "slug flow". Depending upon flow patterns which are functions of channel positions, heat flux distribution and working pressure, the damping constant "d" of transfer function will be negative, zero or positive. It is concluded that the forced circulation loop of parallel channels has proper quantities, as there are such instability phenomena as pump surging and its low power running. (auth)

4267 THE TRANSIENT RESPONSES OF EBR-1. Yoshie Ebizuka, Kazuyoshi Nakanishi, and Masuo Shindo (Tokyo Inst. of Tech.). Nippon Genshiryoku Gakkaishi, 4: 708-12(Oct. 1962). (In Japanese)

The linearized transfer functions from various input quantities to reactor power are derived. The transient responses of EBR-1, Mark II core to step changes in impressed reactivity, coolant flow and inlet coolant temperature are calculated to the interpretation of the dynamic behaviors observed in terms of these transfer functions. (auth)

4268 CALCULATING ROD WORTH IN EPITHERMAL REACTORS. Jacob W. Zwick (General Electric Co., Cincinnati). Nucleonics, 20: No. 11, 82-6(Nov. 1962).

Methods were developed for predicting rod worths in epithermal reactors and were checked against experimental data from a series of SM-I-2 critical experiments. The predicted worths and data were for B_4C rods, B_4C rods in acrylic-plastic hexagons, and stainless steel jackets in acrylic-plastic hexagons. The procedures for analysis of the rods are described in some detail. (D.L.C.)

4269 REACTOR HANDBOOK. SECOND EDITION, REVISED AND ENLARGED. VOLUME III. PART A. PHYSICS. H. Soodak, ed. (Nuclear Development Corp. of America, White Plains). New York, Interscience Publishers, 1962. 322p.

A substantial revision of the first edition, published in 1955, is presented. The data and information are presented in 6 chapters, for each of which separate abstracts were prepared. (J.R.D.)

4270 NUCLEAR DATA. p.3-63 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part A. Physics." New York, Interscience Publishers, 1962.

Nuclear data are presented which are of primary concern in reactor design. The data and other information are presented in sections on the fission process, nonfission sources, range-energy relations, nuclear cross sections, and moderators. (J.R.D.)

4271 EXPERIMENTAL METHODS. p.64-104 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part A. Physics." New York, Interscience Publishers, 1962.

Information and data are presented concerning experimental methods in the areas of neutron sources, neutron detection, source standardization, cross-section measurements, measurements of reactor constants, and critical facilities. (J.R.D.)

4272 THEORY OF NEUTRON TRANSPORT. p.105-51 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part A. Physics." New York, Interscience Publishers, 1962.

Data and information related to the Boltzmann transport equation are presented. This equation and its approximations are discussed in sections on boundary conditions, calculation methods, spherical harmonics solutions, slowing-down problems with and without spatial variation, application of the Sn-approximation to standard problems, and one-group diffusion theory approximation. (J.R.D.)

4273 REACTOR STATICS. p.152-247 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part A. Physics." New York, Interscience Publishers, 1962.

Data and information concerning reactor statics is presented in sections on criticality in an infinite medium, homogeneous reactors, heterogeneity effects in lattices, self-shielding, voids and channels, control rod theory, perturbation theory, reactivity coefficients, and four-factor lattice theory. (J.R.D.)

4274 REACTOR DYNAMICS. p.248-73 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part A. Physics." New York, Interscience Publishers, 1962.

The data and information are presented in sections concerning neutron equations, solutions for the prompt-jump approximation, functions of feedback, transfer, and stability, and problems related to safety studies. (J.R.D.)

4275 CRITICAL DATA. p.274-310 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part A. Physics." New York, Interscience Publishers, 1962.

Critical data are presented as a collection of graphic and tabular figures. Included are sections on nonmoderated systems, and moderated systems using H_2, deuterium, Be, and graphite. (J.R.D.)

4276 REACTOR HANDBOOK. SECOND EDITION, REVISED AND ENLARGED. VOLUME III. PART B. SHIELDING. E. P. Blizard, ed. (Oak Ridge National Lab., Tenn.). New York, Interscience Publishers, 1962. 297p.

A substantial revision of the first edition, published in 1955, is presented. The data and information are given in 9 chapters, for each of which, a separate abstract was prepared. (J.R.D.)

4277 INTRODUCTION: SHIELD DESIGN CRITERIA AND PROCEDURES. H. E. Stern. p.4-15 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

Data and information are presented to provide shield planners with a measure of the available knowledge on shield design and to examine design problems. Sections are included on types of radiation, radiation units and permissible limits, steps in shield design and facilities for shielding experiments. (J.R.D.)

4278 SOURCES OF NEUTRONS AND GAMMA RAYS. Herbert Goldstein. p.16-62 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

Data and information on these sources are presented in sections on neutron sources, gamma radiation sources and

spectra from fission products, and radiative-capture gamma spectra. (J.R.D.)

4279 NEUTRON ATTENUATION. R. Aronson and C. N. Klahr. p.63-101 of "Reactor Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

It is noted that H_2 is a prominent component of most reactor shielding, and considerable information is included on attenuation of neutrons by this element. Neutron attenuation by nonhydrogenous materials is more difficult to calculate, however simplifications are possible which aid in shielding estimates. The information is given in sections on interaction processes, neutron detection and dosimetry, and neutron attenuation by hydrogenous and nonhydrogenous materials, and concrete. Information is also included on neutron streaming in shielding materials. (J.R.D.)

4280 GAMMA-RAY ATTENUATION. U. Fano, C. D. Zerby, and M. J. Berger. p.102-27 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

In general, the photon energies considered are those at 0.1 to 10 Mev. The data and information are presented in sections on elementary interaction processes, aspects of penetration, experimental results, and miscellaneous studies. (J.R.D.)

4281 ANALYTICAL METHODS OF SHIELD DESIGN. E. P. Blizard. p.128-50 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

Information concerning the comparison integration method is presented. This method uses data from a known source and shield configuration to predict the performance of an unknown source and shield; it is restricted to homogeneous configurations. A semi-analytic method is also discussed which can be applied to a non-homogeneous configuration involving a variety of materials. The information is presented in sections on source geometry for homogeneous media, the comparison method of shield design, the semi-analytic method of shield design, and integration methods. Information concerning useful functions is also included along with graphs. (J.R.D.)

4282 DUCTS AND VOIDS IN SHIELDS. David M. Chase. p.151-71 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

It is noted that poor attenuation in various regions of shields can usually be calculated by approximate methods. Descriptions and discussion concerning the several approximate calculational methods are presented along with supporting experimental data. (J.R.D.)

4283 HEAT GENERATION IN SHIELDS. C. N. Klahr. p.172-84 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

Information concerning mechanisms that cause energy transfer to shields is presented. The mechanisms include energy degradation of neutrons by shielding materials, energy degradation and absorption of charged particles which are emitted by nuclei in the shielding resulting from neutron capture, and absorption of gamma radiation in shielding. Procedures for calculating heating rates are included. (J.R.D.)

4284 SHIELD OPTIMIZATION WITH RESPECT TO WEIGHT. E. P. Blizard. p.185-7 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

Criteria are given for use in testing whether weight optimization has been achieved with respect to any shield parameters such as the degree of asymmetry or the distribution of one material in another. The information is presented in sections on general theory, optimization of a spherically symmetrical two-component shield, and parameter optimization. (J.R.D.)

4285 AIR, GROUND, AND STRUCTURE SCATTERING OF RADIATION. p.188-284 of "Reactor Handbook. Second Edition, Revised and Enlarged. Volume III. Part B. Shielding." New York, Interscience Publishers, 1962.

Discussions are presented concerning calculational methods which were devised for special cases not like the general run of shielding problems. These methods vary in difficulty from the straightforward single-scattering-in-air problem to that with scattering and attenuation by airplane structures and crew compartments. The information is presented in sections on air scattering, ground scattering, and structure scattering. (J.R.D.)

4286 METHOD FOR MEASURING THE DISTRIBUTION OF THE NEUTRON FLUX DENSITY. Albert Ziegler (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,126,039. "Application date Sept. 2, 1959."

A method is given for measuring the distribution of the neutron flux density, especially in reactors. The method comprises the application of radioactive indicators of which at least two are exposed simultaneously to the radiation. After a predetermined irradiation time, each of the indicators is brought before a radiation detector. The measurement of the radioactivity takes place at the same time for all indicators. After the measurement, the indicators are re-irradiated at another point in the neutron field where another indicator was previously irradiated. In this way all indicators are irradiated successively at all points where the intensity of the radiation is to be determined, the radiation detectors being always the same for a certain indicator. The counting rates for all indicators for a given point are summed. The ratio of the sums of the counting rates of two points corresponds exactly — if quantities of second order are neglected — to the ratio of the neutron flux density at these points. In applying this method it is neither necessary to have absolutely equal counters nor to have absolutely equal indicators. (H.K.)

4287 NUCLEAR REACTOR WITH FLUID UF_6 FUEL AND METHOD OF OPERATION. Hermann Clasen (to Metallgesellschaft Aktiengesellschaft). German Patent DAS 1,127,005. "Application date June 8, 1957."

A nuclear reactor is described in which pressurized, fluid UF_6 is used as fuel; the pressure being higher than its vapor pressure. Enclosed in the reactor vessel is the core and an expansion machine operating as a plunger-pump. The expanding fluid fuel drives the pump directly. The method described comprises the vaporizing of the fluid UF_6, the expansion and condensation in a turbine, and the feeding back of the condensed fluid into the reactor. (H.K.)

4288 CONTROL ROD FOR NUCLEAR REACTORS. Hermann Kumpf (to Siemens-Schuckertwerke A. G.). German Patent DAS 1,127,507. "Application date July 15, 1959."

A control element for nuclear reactors is designed which consists of a single flexible rod. The rod made of neutron-absorbing materials is shaped so that it becomes flexible due to the elasticity of the neutron-absorbing material. This can be achieved by using a neutron-absorbing tube that has slits. The slits are inclined relative to the axis of the rod and can be distributed along the axis either continually or discontinually. (H.K.)

4289 SAFETY DEVICE FOR GAS-COOLED NUCLEAR REACTORS. Horst Borgwaldt (to Deutsche Babcock and Wilcox-Dampfkessel-Werke A. G.). German Patent DAS 1,136,026. "Application date July 11, 1959."

An "integral" safety device for gas-cooled nuclear reactors is described, comprising gaseous poison under pressure in a small capsule, a Cu–UO_2 plug which is melted when the neutron flux level becomes excessive, and a chamber which is connected to the capsule and into which the poison gas expands after the plug has melted. This safety device is located in the core in one of the cooling channels. The plug is entirely shielded against thermal neutrons. The shields, e.g., cadmium plates, are placed at a certain distance from the plug. In case of damage of the secondary loop, water fills the coolant channels and the space between the plates and the plug. The fast neutrons that penetrate the plates are then slowed down in the water layer before hitting the surface of the plug. The fission heat of the uranium brings the temperature of the plug to its failure point and the poison is ejected. (H.K.)

4290 PILES OF NUCLEAR REACTOR ELEMENTS AND IN PARTICULAR OF MODERATOR MATERIAL ELEMENTS. Roland Louis Roche and Roger Martin (to Commissariat à l'Énergie Atomique). U. S. Patent 3,061,532. Oct. 30, 1962.

The advantages are set forth for piles of nuclear reactor elements in the form of prismatic-shaped blocks and, in particular, of moderator material elements constituting the moderator structure of a reactor having vertical channels. (R.J.S.)

4291 BOILING LIQUID TYPE NUCLEAR REACTOR. André Huet. U. S. Patent 3,063,925. Nov. 13, 1962.

A special feature has been developed for a boiling reactor that involves the disposition of liquid and vapor separators in the boiling liquid. The fuel rods are placed so that the gaps between them can receive the separators. The helical nature of the separators ensures gyration of the circulating liquid. Openings in the wall of a tube located in the axis of the helix allows the vapor to escape axially. (R.J.S.)

4292 STABILIZATION OF ORGANIC COOLANTS AND MODERATORS IN NEUTRONIC REACTORS. Morris R. Ort and William H. Yanko (Monsanto Chemical Co.). U. S. Patent 3,063,927. Nov. 13, 1962.

Sulfur-stabilized polyphenyls have been developed for use as nuclear reactor moderators and/or coolants. The use of biphenyl containing 11 mole % free sulfur is described in detail. (R.J.S.)

Power Reactors

Refer also to abstracts 2753, 3702, 3734, 3742, 3757, 3759, 3827, 3828, 3841, 3843, 3847, 3848, 3849, 3851, 3856, 3857, 3858, 3859, 3860, 3861, 3891, and 4362.

4293 (ACNP-6114(Rev.)) PATHFINDER ATOMIC POWER PLANT PROTOTYPE RECIRCULATION PUMP REPORT. R. A. Haugen and D. J. Nolan (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Oct. 31, 1962. For Northern States Power Co. and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 71p.

The development and testing of a centrifugal pump suitable for use in the recirculation system which forces core coolant and moderator through the core at a high rate are described. The prototype is a vertical single-stage centrifugal pump driven by a 400-hp induction motor. The pump has an overhung impeller which contains a journal for a hydrostatic radial bearing. The pump casing is a circular type with diffuser. A preliminary seal test, preliminary test of lower labyrinth bushing, cold performance test, 200-hour proof test, cooling jacket test, head-capacity test, shaft seal test, and operational test were carried out. The pump support design was checked thoroughly under simulated plant conditions. A pantograph attached at the centerline of each trunnion support recorded thermal expansions. They were about 15 to 20% lower than the calculated values. Maximum pipe stress with a friction force of 4040 lb acting at the supports was calculated as 1500 psi. (M.C.G.)

4294 (ANL-6629) CORE A CRITICAL STUDIES FOR THE ENRICO FERMI ATOMIC POWER PLANT ON ZPR-III. C. E. Branyan (Argonne National Lab., Ill.). Oct. 1962. Contract W-31-109-eng-38. 110p.

A critical studies program for the Enrico Fermi Atomic Power Plant was run with the ZPR-III fast critical facility. The objectives of this program included determination of the U enrichment required for criticality, the effect of minor variations in core and blanket composition, reactivity coefficients, control and safety rod characteristics, power distribution, spectral indices, and the reactivity worth and wave shape of the oscillator rod. The experimental program was separated into two phases. The first phase involved investigations of a clean assembly, which was a simplified and homogenized core and blanket geometry constructed for ease of experimental manipulation and analysis. The second phase involved experiments on the engineered, or as-designed, core. This assembly included such engineering details as control and safety rod channels, core end gaps, and a precise reconstruction of the core outline. This provided detailed information on worths of control rods and fuel subassemblies, power distribution, and the effect of variations in core and end-gap dimensions. The application of critical experiment data to the determination of the Enrico Fermi reactor characteristics has established the U^{235} enrichment for the fuel alloy, worths of fuel subassemblies, and the B^{10} enrichment for the control and safety rods. In addition, material-substitution experiments and fuel-worth measurements have provided the parametric data for the determination of the net temperature coefficient of the Enrico Fermi reactor. (auth)

4295 (DP-740) PROCESSING OF POWER REACTOR FUELS. Eighteenth Quarterly Progress Report, January 1 to April 1, 1962. A. T. Clark, Jr., comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1962. Contract AT(07-2)-1. 24p.

In a continuing study of the anodic dissolution of simulated power reactor fuels using the liquid contact technique, Zircaloy-clad UO_2 fuel assemblies were successfully disintegrated in the semiworks electrolytic dissolver. The ZrO_2 sludge that formed was difficult to keep suspended during transfer to waste storage. In laboratory studies, an optimum voltage was found for disintegrating zirconium, and high uranium losses were detected in the ThO_2 sludge formed in the anodic disintegration of Th-U alloy. Work was initiated on the problems of dissolving sodium-bonded fuels. The rate of corrosion of stainless steel vessels by boiling nitric acid containing dissolved stainless steel was reduced significantly when carbon black or sulfur was present. The reducing agents converted corrosive Cr^{+6} to noncorrosive Cr^{+3} but did not reduce the corrosion caused by high concentrations of iron and nitrate. (auth)

4296 (DP-787) STATUS OF THE UNITED STATES EFFORT IN D_2O REACTOR PHYSICS. John L. Crandall

(Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1961. Contract AT(07-2)-1. 93p.

A summary is given of the current status and the accomplishments of the U. S. program in D_2O reactor physics. Particular emphasis is placed on those aspects of the program dealing with the design of heterogeneous, D_2O-moderated power reactors. (auth)

4297 (GA-3539) DESCRIPTION OF PEACH BOTTOM HTGR CRITICAL ASSEMBLY LOADING WITH CENTRAL EXACT REGION. J. B. Sampson (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 25, 1962. Contract AT(04-3)-314. 17p.

The Peach Bottom 40-Mw(e) HTGR critical assembly built to simulate in a small region the neutron events of the large power reactor is described along with loading techniques. The critical assembly is built of separable halves and controlled by vertical safety rods and a horizontal control rod in each half. The loading closely simulates, at the center, the correct geometry and neutron spectrum of the power reactor. The design, characteristics, composition, and operation of the critical assembly are described and discussed. (N.W.R.)

4298 (HPR-26) EXPERIENCE FROM THE OPERATION OF THE HALDEN HEAVY WATER BOILING REACTOR ON ITS FIRST FUEL CHARGE, JUNE 1959 TO APRIL 1961. H. Ager-Hanssen, F. H. Enger, O. R. Kåsa, and R. Rose (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). Sept. 1962. 329p.

Results and experience obtained from the operation of the Halden Heavy Water Boiling Reactor (HBWR) on its first fuel charge are described. Topics covered include: the physics of boiling water reactors, reactor statics program, reactor dynamics program, heat transfer, in-core instrument program, operational characteristics, component performance, fuel performance, heavy water, radioactivity levels in plant, containment, and experimental operation. (M.C.G.)

4299 (MND-M-1825) PM-1 NUCLEAR POWER PLANT PROGRAM. 14th Quarterly Progress Report, June 1, 1962 to August 31, 1962. (Martin Co. Nuclear Div., Baltimore). Sept. 1962. Contract AT(30-1)-2345. 85p.

Activities in a program for design, development, fabrication, installation, initial testing, and operation of a prepackaged, air-transportable nuclear power plant, the PM-1 are reported. The specified output of the system is 1 Mw(e) and 7 million Btu/hr of heat. The principal efforts during the preceding report period were concerned with plant testing, modifications to the plant to enable it to produce full design load at high ambient temperatures, and the compilation and evaluation of plant performance data. (auth)

4300 (NAA-SR-6403) POWER FLATTENING IN SODIUM GRAPHITE REACTOR CORES. F. J. Jankowski (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 30, 1962. Contract AT(11-1)-Gen-8. 59p.

Although most reactors were constructed with uniform fuel and moderator characteristics, it is possible with nonuniform material distribution to improve reactor power and temperature characteristics. Approaches to such improvement by nonuniform fuel distribution, nonuniform fuel enrichment, nonuniform moderator density, nonuniform moderator materials distribution, and nonuniform absorber distribution were investigated. Distribution functions are derived for the parameters to be varied. Three of these methods are considered for application to the SGR critical assembly. The necessary distributions for nonuniform enrichment, nonuniform spatial fuel distribution, and nonuniform absorber distribution are obtained, along with the approximations necessary for experiments on the SGR critical assembly. (auth)

4301 (NP-10458(Vol.8)) ENRICO FERMI ATOMIC POWER PLANT REVISED LICENSE APPLICATION. PART B, VOL. 8. PROPOSED TECHNICAL SPECIFICATIONS. PART I. OPERATION AT LEVELS IN EXCESS OF ONE MEGAWATT. PART II. OPERATION AT LEVELS NOT IN EXCESS OF 200 MEGAWATTS (PRELIMINARY DRAFT). (Power Reactor Development Co., Detroit). [196?]. 93p.

Technical specifications are presented to establish limitations (1 and 200 Mw) beyond which the facility is not to operate. The site, containment, primary sodium coolant system, primary plant auxiliary systems, secondary sodium coolant system, steam and feedwater system, emergency cooling systems, reactor core and blanket, control and safety systems, monitoring systems, waste disposal systems, fuel storage facilities, administrative organization and safeguards, experimental facilities, initial reactor loading, and program of operations are considered. (M.C.G.)

4302 (RISÖ-49) SECOND PROGRESS REPORT FOR THE DOR DESIGN STUDIES. P. L. Oelgaard, ed. (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Sept. 1962. 79p.

A general review of the work performed, including an account of design changes and a discussion of the major problems remaining to be solved, is presented. Fuel element design and related experiments are reviewed. The DOR reactor physics investigations were concentrated on development of calculation methods and computer codes and on measurements of DOR lattices in the EXPO exponential experiment. Calculations of the thermal properties of the reactor were performed. An out-of-pile loop was erected, and investigations on measurements of thermal conductivity in organic liquids were carried out. The metallurgical investigations were concentrated on examinations of SAP (Sintered Aluminum Product) and a UO_2 prototype fuel element. Chemical investigations were concerned mainly with the pyrolytic stability of organic coolants. (auth)

4303 (SC-4459(RR)) DESIGN STUDY FOR HOMOGENEOUS PHOSPHORIC ACID REACTOR (HPAR). (Sandia Corp., Albuquerque, N. Mex.). Aug. 1960. Contract [AT (29-1)-789]. 45p.

Results of a study to determine the feasibility of a homogeneous phosphoric acid reactor for use as a military packaged-power facility are presented. Considered in the report are applications, results of design phases, test installations, and cost and time estimates. (J.R.D.)

4304 (SL-1974-2) ENGINEERING EVALUATION STUDIES, HEAVY WATER MODERATED POWER REACTOR PLANTS. Quarterly Progress Report, July–September 1962. (Sargent and Lundy, Chicago). Oct. 23, 1962. Contract AT(38-1)-213, modifications 7, 8, and 9. 13p.

Work on the computer program for the economic optimization of D_2O moderated power reactors, which is being done in conjunction with du Pont, is continuing. Terminal report (SL-1949) for fiscal year 1962 presents complete operating and cost data characterizing all the 300 Mwe turbine plants. The design and cost equations for the 300 Mwe liquid D_2O, boiling D_2O and organic cooled reactor plants are also discussed. These data are summarized. Turbine cycle efficiency curves as a function of final feedwater temperature were completed for all the 500 and 1000

Mwe turbine plants. Detailed cost breakdowns for the 500 and 1000 Mwe turbine plants were completed except for one or two cost components. Publication of these data was delayed pending receipt of these data from the equipment manufacturers. The design and cost equations for the 500 and 1000 Mwe liquid D_2O, boiling D_2O, and organic cooled reactor plant auxiliaries and structures are being developed The compilation of technical and cost data associated with the components of the H_2O fog and gas cooled reactor plants is continuing. (auth)

4305 (SRO-74) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, OCTOBER 1962. (Savannah River Operations Office, AEC). 13p.

Progress is reported on the AEC-AECL cooperative program, development of sintered aluminum products, nondestructive tests, header and feeder piping fluid dynamics, zirconium technology, heat transfer at low heat flux, physics, metallurgy, engineering, the Heavy Water Components Test Reactor, and the Carolinas-Virginia Tube Reactor. (M.C.G.)

4306 (TID-17231) CALCULATIONS OF THERMAL SPECTRA IN ORGANIC-COOLED, D_2O-MODERATED POWER REACTORS. H. D. Brown (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Nov. 1962]. Contract AT(07-2)-1. 7p.

Physics calculations for tubular fuel assemblies were made in connection with a program on power reactor optimization. The neutron temperatures and effective cross sections as functions of the coolant temperature were obtained from calculations with the THERMOS code. The survey included systems containing two and three natural uranium carbide tubes per assembly which were cooled with Santowax-R at temperatures ranging from 20 to 350°C. Scattering kernels, neutron spectra, reactivity coefficients, and burnup were calculated. (M.C.G.)

4307 (TID-17288) APPLICATION OF OPTIMUM CONTROL TO NUCLEAR REACTOR START-UP. C. N. Shen (Rensselaer Polytechnic Inst., Troy, N. Y.) and F. G. Haag (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 23p.

A form of the reactor kinetics equations is developed which is suitable for application of optimization techniques. The mechanization of the modified reactor kinetics equations uses instruments already developed. Optimization techniques are applied to the desired start-up program of constant period followed by operation at constant power. The optimum controller employs only two amplifiers with time varying gains. (auth)

4308 (TID-17297) DESIGN TRENDS FOR D_2O REACTORS. J. W. Wade (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Nov. 1962]. Contract [AT(07-2)-1. 8p.

Design factors of particular concern in D_2O power reactors are charge rate on capital investment, use of slightly enriched fuel, and temperature limits for uranium metal fuel. Design changes that should be made as such parameters are varied have been provided by a cost optimization code developed by Du Pont and Sargent and Lundy. The design parameters and energy costs for 300 Mw electric D_2O power reactors are summarized for five different cases. Examples are presented of the effects of changes in the charge rate, use of enriched fuel, or use of metal fuel on some of the individual design parameters. (H.D.R.)

4309 (UCRL-7036(Pt.5)) TORY II-C CONTROLS SYSTEM— PART 5 OF THE TORY II-C PROGRAM. E. A. Sheridan, J. A. Day, W. I. Edwards, R. B. Hollstien, D. J. Peschel, and R. G. Staker (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 20, 1962. Contract W-7405-eng-48. 59p.

Requirements for the Tory II-C control system are discussed. The airflow and nuclear power control systems are described. The air-supply control consists of two relatively independent systems for controlling flow rate and temperature. Four shim-rod actuators control the shim rods for gross reactivity control. Two vernier-rod actuators are used for fast reset and calibration functions. The five basic modes of nuclear control, manual, log-power, core-temperature, fast reset, and scram, are discussed. Analyses and tests of the control systems are described. (M.C.G.)

4310 AN EVALUATION OF SOME HEAVY-WATER-MODERATED POWER-REACTOR CONCEPTS. Kåre Hannerz. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 29-68(1962). (In English)

An investigation was made at the ASEA Nuclear Power Division in order to compare the economic merits and development potentialities of some heavy-water-moderated natural-uranium-fueled types of power reactors. The main purpose was to find out whether any of the examined concepts appeared more promising for the future than the pressurized heavy-water-cooled, tank-type reactor, which has up to now formed the basis for most of the reactor development work within Sweden. The conclusion drawn from this investigation was that direct-cycle boiling-water reactors, eventually with nuclear superheating, and the CO_2-cooled reactor, offer significant advantages over the pressurized-water reactor, and should be considered for the Swedish heavy-water reactor development program. (auth)

4311 A 235 MW (el.) ROCK VESSEL REACTOR POWER PLANT. Kristian Dahl Madsen. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 69-80(1962). (In English)

A brief description is given of a nuclear power-station with one rock vessel reactor and an electrical output of 235 Mw. The reactor is of the gas-cooled, graphite-moderated type, and the fuel is natural uranium in the form of magnesium-clad metallic rods. The pressure vessel consists of a rock chamber with an inner liner of steel-clad concrete. A comparison is drawn between the rock vessel reactor and the above-ground version of the gas-cooled, graphite-moderated reactor. (auth)

4312 HEAT-TRANSFER EXPERIMENTS ON A FUEL-ELEMENT MODEL. HYDRAULIC AND THERMAL INVESTIGATIONS ON A FULL-SCALE MODEL OF A FUEL ELEMENT FOR THE R3/ADAM REACTOR. John Bengtsson and Carl Goesta Skygge. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 81-98(1962). (In English)

Measurements were made of the pressure drop for one, and two, phase flow (water-steam) in the cooling ducts of a fuel element, as well as measurements of the steam void fraction and the slip factor for two-phase flow. The measurements performed show throughout good results. Curves showing the hydraulic stability and an approximate expression for calculating the steam void fraction are given. (auth)

4313 TEMPERATURE TRANSIENTS OF THE OUTLET WATER OF A FUEL ELEMENT IN A D_2O-COOLED REACTOR. Olov Rydén. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 211-20(1962). (In English)

If the flow of water through a fuel element in a pres-

surized-water reactor is suddenly reduced, this will lead to a rapid temperature rise, which may damage the fuel element. By supervising the temperature of the outlet water, it is possible to prevent such damage before it is too late. The temperature transients caused by a stepwise change in the water flow were determined with the aid of the Laplace transform for a fuel element, where the water temperature is assumed as the first approximation to be homogeneous for the entire element. The results were then correlated with an actual fuel element with practical dimensions, the transport delay of the water also being taken into account. (auth)

4314 A BOILING SLURRY REACTOR CONCEPT. Olle Lindstroem and Bjoern Widell. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 239-70(1962). (In English)

The basic features of the David power reactor concept are discussed. This advanced concept is a boiling-slurry reactor, fueled with a dispersion of thorium and enriched uranium oxides in heavy water. The primary system is of the simplest possible design, in order to minimize plant-investment and maintenance costs. The research and development efforts necessary to carry through the project are expected to be moderate, since most components and materials are conventional and operating temperatures not excessively high. At present the evaluation of the economic feasibility of the concept is of prime concern. Some experimental work is in progress in which factors of economic importance to the project are being studied, mainly saturated boiling and radiolytic-gas recombination. The exciting prospects of this concept seem to warrant further study. In-pile experiments on steam separation in boiling slurries should be in the next objective. (auth)

4315 CALCULATION OF THE FUEL COSTS FOR A NUCLEAR POWER-STATION. Ragnar Liljeblad. ASEA (Allmanna Svenska Elektriska Aktiebolaget) Res., No. 7, 321-4(1962). (In English)

Expressions are given for the calculation of the annual fuel costs, both when physical and metallurgical factors set the limit of the burn-up. The reduced-value method forms the basis for the calculations. (auth)

4316 ARE FAST REACTORS WITH LOW FUEL CONCENTRATIONS POSSIBLE? J. Clauss. Atomkernenergie, 7: 319-20(Sept. 1962). (In German)

A fast reactor system is discussed. Instead of the high fuel concentration used in fast reactors built today, the reactor described will be fueled in the equilibrium cycle with natural uranium. If it is possible to realize this reactor, the nuclear-power economics would be more optimistic. The following assumption is made: In a natural uranium fuel element, exposed to a fast neutron flux, an excess reactivity is produced. Under certain conditions a gross estimation may show the possibility of the performance of such a reactor system. The start of these reactors and the performance of the initial core are not easy. Only a long-time development program can remove the difficulties in this reactor concept. (auth)

4317 FLUID MOTORS DRIVE CONTROL RODS OF NUCLEAR REACTOR. E. Ledin (General Atomic Div., General Dynamics Corp., San Diego, Calif.), A. M. Harris, and W. D. Childs. Hydraulics and Pneumatics, 69-72(July 1962).

Design and operation of a fluid motor in the Peach Bottom Power Reactor are described. This motor pulls the reactor control rods down from the bottom of the core to increase reactivity. (R.J.S.)

4318 PRESTRESSED CONCRETE PRESSURE VESSELS. Kurt Billig (Coll. of Advanced Tech., UNESCO Mission in Libya, Tripoli). J. Am. Concrete Inst., 59: 1601-34(Nov. 1962).

Basic information is presented for concrete pressure vessels for use in nuclear power stations of the British type. The major factors of heat, the prestressing process, and plastic deformation are considered. General design principles are emphasized. (D.L.C.)

4319 THE SOLUTION OF COMPLEX OPTIMIZATION OF PARAMETERS OF A NUCLEAR POWER STATION WITH HEAVY WATER, GAS-COOLED REACTOR BY MEANS OF AUTOMATIC DIGITAL COMPUTERS. Ladislav Bohal. Jaderńa Energie, 8: 348-55(1962). (In Czech)

Instruction is given on the use of automatic computers for complex optimization of parameters of a nuclear power station with heavy water, gas-cooled reactor. Some results of research work gained with the aid of automatic computers are reported. (auth)

4320 OLDBURY DESIGN APPRAISAL. Nucl. Power, 7: No. 79, 44-50(Nov. 1962).

The Oldbury nuclear power station, fueled by two Calder Hall reactors and designed for an output of 560 Mw(e) is being built. Pre-stressed concrete pressure vessels will be used in place of steel vessels. The design of the station is described in some detail. An appraisal of the advantages of pre-stressed concrete vessels is given. (D.L.C.)

4321 HALDEN OPERATING AND RESEARCH EXPERIENCE. Henrik Ager-Hanssen (OECD Halden Reactor Project, Norway). Nucl. Power, 7: No. 79, 57-65(Nov. 1962).

The present $4\frac{1}{2}$-year program started in July 1958 and will end in Dec. 1962. Reactor statics experiments were carried out on the first fuel charge: void reactivity coefficients, temperature reactivity effects, flux distortion due to steam voids, effects of enriched spike elements, and control rod measurements. Dynamic measurements of the power transfer function show excellent reactor stability. Two theoretical models are given for the interpretation of dynamic measurements. The effects of reactor operation on D_2O quality, activity levels, and fuel elements are described briefly. The second fuel charge was inserted in March 1962, and the future program of operation and research is outlined. (D.L.C.)

4322 REACTORS ON THE LINE NO. 13—NPD. Nucleonics, 20: No. 11, 47-52(Nov. 1962).

A detailed design description is given for NPD, a 20-Mw(e) pressurized-water reactor. The startup and early operating experience are described briefly. (D.L.C.)

4323 MOISTURE CONTROL IN NUCLEAR SUPERHEATING. John F. Wilson and Ronald J. Grenda (Allis-Chalmers Mfg. Co., [Milwaukee]). Power, 106: 70-2(Feb. 1962).

Elimination of moisture entrainment is necessary to prevent radioactive contamination in the plant cycle of a boiling water reactor with an internal nuclear superheater. Entrainment can be eliminated by separation of phases. To get adequate water surface for primary separation by natural mechanisms in a boiling water reactor, it seems practical to provide the needed height in the steam dome. Any of several types of mechanical separators can be installed within the reactor vessel to remove the secondary trace amounts of moisture. (R.J.S.)

4324 NUCLEAR POWER REACTOR STABILITY. Henri Smets. Brussels, Presse Universitaire de Bruxelles, 1960. 312p. $10.00.

Analytical methods, and in particular topological methods and Liapounoff's second method, are applied to the problem of power reactor stability. Stability and instability theorems are obtained for the cases of linear and nonlinear reactivity-power dependence. The problems of stability of homogeneous and heterogeneous reactors are studied. Properties of stability in the large are derived. Special problems on the effect of an external control system and on the effect of burnable fission products are also treated. (auth)

4325 NUCLEAR POWER PLANT FOR THE GENERATION OF SUPERHEATED STEAM. Andreas Setzwein and Helmut Braun (to Brown, Boveri and Cie A. G.). German Patent DAS 1,128,573. "Application date June 6, 1959."

A nuclear reactor with a heterogeneous core is provided in the proposed nuclear power plant for the generation of superheated steam. The core is built of a solid block of moderator material pierced with heating elements. The heating elements comprise a fuel element surrounded by a tube. The heat generated in the core is removed by two primary coolant loops. The coolant in one of the loops serves for generating superheated steam. This coolant is pumped through the tube and is in contact with the fuel element. The coolant in the other loop flows in the space between the tube and the solid moderator block. This loop is designed to generate saturated steam. By using two primary coolant loops at two different temperatures it is possible to design an integral core which comprises one of the known low-temperature cores and one of the known high-temperature cores. (H.K.)

4326 FISSION REACTOR. Werner Mialki and Rudolf Wille. German Patent DAS 1,130,941. "Application date Feb. 20, 1960."

The homogeneous thermal fission reactor described consists of a core in which BeO and UO_2 are provided at such a ratio that it becomes critical. The BeO and UO_2 are fluidized with molten glass. The molten glass is contained in a graphite tank which serves as a reflector. It is believed that a reactor of this type can be operated at temperatures above 1000°C. (H.K.)

4327 CONTROL MEANS FOR A BOILING WATER NUCLEAR REACTOR POWER SYSTEM. Robert H. Shannon and Harold E. Williamson (to United Engineers and Constructors Inc.). U. S. Patent 3,061,533. Oct. 30, 1962.

A simple method has been developed for increasing the power output of a boiling water type nuclear reactor power system in response to sudden increases in load without rendering the system unstable. (R.J.S.)

4328 METHOD OF OPERATING A NUCLEAR REACTOR. Edward M. Poole and Donald C. Schluderberg (to The Babcock and Wilcox Co.). U. S. Patent 3,063,926. Nov. 13, 1962.

A method has been developed for cooling a nuclear reactor and transporting the heat to a remote energy converter. A fluidized mass of finely divided solids carried in the gas stream is passed in heat transfer relationship with the heterogeneously arranged fissioning material within the reactor. (R.J.S.)

Production Reactors

4329 (HW-71251) A TECHNIQUE FOR APPRAISAL OF NPR STACK GAS SYSTEMS. G. E. Zima (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 4, 1961. Contract AT(45-1)-1350. 15p.

A simple analysis is outlined which appears to be useful in estimating the trend in stack gas composition from a given initial composition as well as the values of purification system parameters needed to hold desired levels of stack gas constituents. While the N Reactor is the focus of attention, the analysis might prove useful for existing production reactors. (auth)

Research Reactors

Refer also to abstracts 2769, 3692, 3804, 3826, 3829, 3830, 3831, 3832, 3833, 3834, 3844, 3846, and 3850.

4330 (IDO-16781) MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT JANUARY 1–MARCH 31, 1962. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 15, 1962. Contract AT(10-1)-205. 82p.

ETRC measurements were made to confirm design parameters proposed for a new MTR shim rod. Increases of 13 and 26% were recorded for the thermal neutron flux peak occurring in the water region between the fuel plates and the poison section of a partially withdrawn control rod, when the water gap was changed from $\frac{3}{8}$ in. to heights of 1 in. and $1\frac{3}{4}$ in., respectively. It also was determined that boron-stainless steel flux suppressor plates in ETR control rods were relatively more effective than nickel ones in reducing the pronounced thermal flux peaking. The maximum peak was reduced 29% by using boron-stainless steel plates as compared with a 17% reduction obtained with nickel suppressors. Preliminary values were obtained for the resonance absorption integral of natural Dy, natural W, W^{184}, and W^{186}. Measurements of activities of Lu^{175} and Lu^{176} in a natural Lu-Cu system were compared with those of a Au-Cu system for neutron flux spectrum determinations. The results showed that natural Lu is potentially useful for this purpose, but that presently available values of some of its nuclear constants are not sufficiently accurate. A program (FLUSY) was written for the IBM 650 to compute the necessary flux synthesis values of group-dependent buckling and flux-weighted reactor constants. A sample design was finished for use in the long-term burnout study of the Th-U^{233} conversion chain. The design consists of a 1-in.-diameter × 4-in.-long 75-gram active core containing a maximum of 2.5 wt % of U^{233}, with the remainder Th^{232}, and clad with either Zr or Zircaloy-2. Tensile testing was completed on 94 irradiated fuel-plate specimens with fuel cores of Al-U alloys, UO_2-Al cermets and U_3O_8-Al cermets clad with Al alloys. The most significant effect, resulting from fission damage, was the loss of ductility. The fission cross section of Pu^{241} was measured from 0.025 to 100 ev. A value of 965 ± 40 barns was obtained for the 0.025 ev fission cross section based upon a normalization to the total cross section at the 6 ev level. A Be sample with a fast neutron dosage of 0.891×10^{21} n/cm^2 and a thermal neutron dosage of 1.001×10^{22} n/cm^2 was completely melted in the vacuum line apparatus for gas analysis. The total gas content determined by calculation agreed quite well with the gaseous products collected and analyzed. A series of swelling vs temperature experiments was commenced on Be samples with irradiation histories similar to the Be sample just described. In addition to swelling it was determined that evolution of reaction product gases at elevated but sub-melting temperatures also constitutes a potential hazard associated with Be components in reactors. The specific 180-kev gamma emission rate for pure Ho_2O_3 was determined after six months irradiation in the MTR for a total nvt of ~5.6×10^{21} n/cm^2, followed by a four-month cooling period and purification of the weighable oxide sample. This permits determination of the half

life if the isotopic abundance of Ho^{166} can be measured. An average value for the half life of Sb^{122m} was calculated as 4.21 ± 0.02 min by the IBM 650 computer using a weighted least-squares method. Yield ratios of $In^{114}-In^{114m}$, produced by activation of 95%-enriched In^{113}, were measured directly by following the β-decay through an absorber. The values obtained were Y = ~2.5 for thermal neutrons and Y = ~1.7 for epi-cadmium neutrons. Data on the inelastic scattering of slow neutrons from Na were obtained at incident neutron beam energies of 0.026, 0.07, and 0.10 ev for sample temperatures of 23, 100, 110, and 150°C. The study of five computational methods for calculating partial differential scattering cross sections was made and an evaluation of the methods prepared. Examination of the full range of experimental results for the influence of interference scattering on the scattering of slow neutrons by methane is now possible because laboratory studies have shown that a correct quantum treatment of the rotational motion of methane is required to explain the scattering of low energy neutrons at forward angles. Also, computational procedures were improved, and now large momentum transfers can be calculated. A comprehensive review of the current status of conversion-electron spectroscopy used in decay scheme studies was compiled and is presented. Evidence for direct beta feeding of the 1.57-Mev state of Mo^{94} from the decay of 6.6-min Nb^{94m} was noted during coincidence experiments. A programmer control was designed for the Nuclear Data ND-130 Analyzer which allows a restart after a prescribed time interval and also improves the maintenance schedule by turning off the tape perforator until required. Additional isolation was required in order to suppress noise in the ARMF regulating rod digital readout. This isolation includes output amplifiers at the angle encoder. A gated scaler and paper tape punch control unit was constructed for recording statistical data from neutron pulse counting systems. A magnetic tape pulse recorder was designed to record three channels of individual neutron counts and a 100-kc timing reference channel to go with the gated scaler and data recording system. A time code generator was constructed to allow time marking on 16-mm motion picture film for use in transient information. A discrete time interval distribution of random pulses is derived from the binomial distribution that can be numerically evaluated from standard tables. An overvoltage protector was designed which protects high-voltage systems when the pass tube in the high-voltage power supply shorts out. A circuit was designed that provides two timing pulses whose separation time is proportional to the ratio of one pulse to the sum of both pulses, where the pulses are the amplitudes of two 1-microsecond variable-height input pulses. An instrument was designed which measures the phasing of two-phased choppers in the MTR velocity selector to five parts in 10^5 corresponding to approximately two minutes of phase shift. A method was derived to obtain a rate signal from a mechanical milling machine without using a tachometer which utilizes the back emf of the motor but eliminates the effect of the armature current. An improved air monitoring system was developed which will monitor the amount of alpha and beta activity in the air and give the ratio between the two. The following IBM 650 programs were completed and placed in service: an LSGF-1 program to perform a quantitative analysis, by the method of least squares, on gamma ray spectra obtained from the 256-channel analyzer, a MUFTR-E program using cross section and resonance decks from the MUFTR library to obtain averages of certain cross sections over the flux spectrum from a program problem, a REP1 program using the cross section and resonance decks of the MUFTR library to calculate resonance escape probabilities used in determining "L" factors for MUFTR, the BALD1 program to reduce and normalize data taken during testing of the chemical control out-of-pile loop, and a program called FLOOK which was written to compute the periodic input signal of a linear network when a periodic output signal and the transfer function are known. The IBM 650 one-dimensional diffusion theory code (DDM) was again modified after it became apparent that the neutron balance used was not satisfactory. (auth)

4331 (IDO-16805) MATERIALS TESTING REACTOR–ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, APRIL 1–JUNE 30, 1962. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Sept. 14, 1962. Contract AT(10-1)-205. 63p.

Separate abstracts have been prepared for four sections of this report. The sections deal with reactor engineering and physics, nuclear physics, instrument development, and applied mathematics. (N.W.R.)

4332 (IDO-16805(p.1-6)) REACTOR PHYSICS AND ENGINEERING. R. A. Grimesey, B. L. Rushton, et al. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

Studies of the variation of vertical neutron leakage in the ARMF core as a function of the radial distance from the center of the water hole indicate that little variation in vertical leakage occurs over the ARMF core. A four-group diffusion calculation was made on a special core in the ETRC. A comparison between calculated and measured activation distributions showed that the calculation adequately represented the epithermal distributions. The calculated thermal distributions were in good agreement with the measured values except in the control rods. (auth)

4333 (IDO-16805(p.7-35)) NUCLEAR PHYSICS. M. S. Moore, J. R. Smith, et al. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

The total cross section of Pu-238 was measured using the MTR fast chopper over the energy range 0.02 to 100 ev. With the use of an unseparated sample of irradiated Th-232, the total cross section of Pa-233 also was measured by employing the radioactive sample changer in conjunction with the MTR fast chopper. Preliminary measurements of the total cross section of natural lutetium also were made. A new spectrometer arm control and data print-out system was installed in the MTR crystal spectrometer to permit faster and more accurate taking of data. A new set of improved high resolution collimators also was installed in the spectrometer. The half life of Ho-166 was determined as 90,000 ± 18,000 years. The conversion coefficient for the 57-kev transition in Ir-192m was measured as 3400 ± 300. Yield ratios for isomeric pairs formed by neutron capture were measured for Sb-122–Sb-122m, In-114–In-114m, and Rb-86–Rb-86m. Swelling-temperature-time relationships were determined for beryllium irradiated to 1×10^{21} fast n/cm^2 for temperatures of 800, 900, and 1000°C. Another sample of U-236 containing <0.003% U-235 was prepared. The MTR cold neutron facility was improved by replacement with superior neutron choppers and by installation of improved shielding. Measurements of the dispersion relation for waves propagating in the [0 0 1] and [0 1 1 0] directions in beryllium were made using the MTR velocity selector, and the data were compared with lattice dynamic models. Measurements of the inelastic scattering of slow neutrons from liquid sodium were completed with data taken at 0.025, 0.7, and 0.1 ev for temperatures of 23, 100, 150, and 200°C and the data (except at 200°C) machine-processed through cross section and scattering law. (auth)

4334 (IDO-16805(p.36-43)) INSTRUMENT DEVELOPMENT. N. Wilde, T. J. Boland, et al. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

A theoretical analysis and numerical evaluation of an electrical white noise source has resulted in design curves from which a random Poisson pulse generator can be designed. The usefulness of this generator can be extended to simulate by electrical signal information a time-varying nuclear radiation source. Complete redesign of the instrumentation and control for the MTR neutron crystal spectrometer includes the use of an all-electronic scanner which has resulted in a highly reliable data accumulation system. A remotely controlled milling machine has resulted from modifications to a Bridgeport milling machine. The servomechanisms design has resulted in milling with only electrical connections between the operator and the mill. A very desirable notch filter was designed for use particularly with servomechanism equipment. The filter operates from d-c to 100 cps with a maximum depth or height of the notch of 40 db. The field test on the alpha-beta air monitor recently placed in operation shows that the alpha to beta ratio yields additional information for use by health physicists. (auth)

4335 (IDO-16805(p.44-9)) APPLIED MATHEMATICS. W. A. Hestir, L. L. Marsden, et al. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

The telephone data transmission system using the IBM 1401-1009 in Idaho Falls was put into operation with the 7701-1401-7090 data processing system in Bartlesville. A number of 7090 programs were completed, and others are in various stages of completion. A versatile double precision matrix inversion program was coded in FORTRAN and checked out. The IBM 650 programs for gamma spectrum analysis are being expanded and converted to the 7090. In addition a number of new codes for the IBM 650 were completed. (auth)

4336 (LAMS-2755) LEAKAGE NEUTRON SPECTRUM OF U^{233} CRITICAL ASSEMBLY. Larry E. Bobisud (Los Alamos Scientific Lab., N. Mex.). Sept. 1962. Contract W-7405-eng-36. 20p.

The leakage neutron spectrum of a U^{233} spherical critical assembly (Jezebel) was measured using nuclear emulsions as radiator and detector. The spectrum obtained is compared with similar measurements on the U^{235} and Pu^{239} analogues of Jezebel U^{233}; it is found to agree closely with that of the Pu^{239} assembly and to be harder than that of the U^{235} assembly. All three spectra are compared with theoretical spectra obtained from a numerical approximation to the neutron transport equation. (auth)

4337 (ORNL-TM-380) PREDICTION OF EFFECTIVE YIELDS OF DELAYED NEUTRONS IN MSRE. P. N. Haubenreich (Oak Ridge National Lab., Tenn.). Oct. 13, 1962. Contract [W-7405-eng-26]. 25p.

Equations were developed and calculations were made to determine the effective contributions of delayed neutrons in the MSRE during steady power operation. Nonleakage probabilities were used as the measure of relative importance of prompt and delayed neutrons, and the spatial and energy distributions of the prompt and delayed neutron sources were included in the calculation of these probabilities. Data which indicate a total yield of 0.0064 delayed neutron per neutron were used to compute total effective yields of 0.0067 and 0.0036 for the MSRE under static and circulating conditions respectively. (auth)

4338 (TID-17268) MEASUREMENTS ON A SYMMETRICAL ATR CORE WITH NINE A-1 LOOP MOCKUPS. R. H. Lewis, A. L. MacKinney, and J. W. Poston (Babcock and Wilcox Co. Critical Experiments Lab., Lynchburg, Va.). Aug. 1962. For Ebasco Services, Inc., New York. Contract [AT(10-1)-1075]. 39p. (ATRCE-101)

Flux measurements have been made on an ATR Core constructed especially to achieve core symmetry about any octant or quadrant line passing through the center of the core. The reference core loading of A-1, A-3, and A-5 experiment mockups was converted to nine A-1 experiment mockups. Approximate worth of the neck draw rods was $8.00 for the twenty-four $\frac{3}{8}$-inch-diameter rods. In addition, activations were made with dysprosium and gold at the center plane of the core, and a vertical distribution in the fuel region indicated an axial buckling of 5.48×10^{-4} cm^{-2}. Cadmium ratios of dysprosium were measured in the core and reflector. (auth)

4339 (TID-17270) ATR CRITICAL EXPERIMENT FACILITY DESCRIPTION AND INITIAL CRITICAL CONDITIONS. A. L. MacKinney and J. W. Poston (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). July 1962. For Ebasco Services, Inc., New York. Contract [AT(10-1)-1075]. 51p. (ATRCE-100)

The Advanced Test Reactor Critical Experiment (ATRCE) is described and data are presented from chemical analyses of components. Core design, loading, and criticality conditions are given. Preliminary control cylinder sensitivities and the prompt neutron decay constant at the critical conditions were measured. The decay constant was used to determine the worth of a variety of fully inserted rods. (H.D.R.)

4340 (TID-17271) ISOTHERMAL TEMPERATURE EFFECTS IN THE ADVANCED TEST REACTOR CRITICAL EXPERIMENTS. A. L. MacKinney and J. W. Poston (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Oct. 1962. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 16p. (ATRCE-102)

Isothermal temperature effects were measured in an ATR Critical Experiment core containing two strips of borated mylar film on each plate, no neck draw rods, and control cylinders at an initial position of approximately 100 degrees. Two sets of measurements were made because the first set of data indicated uncertainties in both temperature and reactivity measurements. Both measurements indicated slightly positive temperature coefficients initially. The first measurement indicated a change of sign at higher temperatures, while the second indicated a slightly less positive effect at higher temperatures. An additional measurement of isothermal temperature effects was made in an ATRCE Core with no borated plastic in the fuel region. Core reactivity was held by two fully inserted safety rods in Lobe Positions 1 and 9, and an additional measurement was made with a third safety rod inserted in Lobe 5. A reactivity loss of 31.1 cents was obtained by increasing core temperature from 21.7 to 39.7 C with two safety rods inserted; a reactivity loss of approximately 67 cents was obtained by increasing core temperature to the same degree with the three safety rods fully inserted. (auth)

4341 (TID-17281) FLUX DISTRIBUTIONS IN UNBALANCED ATRCE REFERENCE CORES. J. W. Poston, G. W. Fiscus, and R. H. Lewis (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Oct. 1962. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 51p. (ATRCE-103)

A series of flux measurements was made in unbalanced ATRCE cores. The flux was measured in all of the fuel elements, radially and circumferentially through the individual elements. The following power splits, as defined by the average power in eight elements of a lobe, were measured (the center number is the average of the eight elements

around the center flux trap): Run 136, 40-65-65; Run 137, 40-63-60; and Run 196, 40-55-57. In addition, the thermal flux at the centerplane was determined in neutrons per square centimeter-second for Run 196 as follows: Test Loop A-5 (Lobe 1), 3.08×10^7; Test Loop A-5 (Lobe 2), 3.92×10^7; and Test Loop A-1 (Lobe 3), 5.11×10^7. The reactivity worth of two partially inserted hafnium neck draw rods was measured under three separate reactor conditions: six neck draw rods in each neck, control cylinders balanced; six neck draw rods in each neck, control cylinders unbalanced; and ten neck draw rods removed, control cylinders balanced. The total worth of the neck draw rods depended on the balanced or unbalanced positions of the control cylinders and also varied as a function of the number of draw rods in the neck filler piece. Partially inserted draw rods had little effect on the peak-to-average axial flux ratio computed for the axial distribution through the fuel region, the experiment mockup, and the reflector. (auth)

4342 (TID-17282) EXPERIMENTAL REACTIVITY EVALUATION OF THE ADVANCED TEST REACTOR CRITICAL EXPERIMENT. J. W. Poston and A. L. MacKinney (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Nov. 1962. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 25p. (ATRCE-105)

The reactivity of the Advanced Test Reactor Critical Experiment (ATRCE) was evaluated with the core in the reference condition. Control cylinders were calibrated using determinations of positive reactor periods interpreted by the in-hour equation. The pulsed neutron technique was used to measure subcritical reactivities. Described are the reactivity evaluations for the hafnium neck shim rods, the outer shim control cylinders, and the borated Mylar tape used in the core region. The results of perturbation measurement of the reactivity coefficient of U^{235} are included. (H.D.R.)

4343 (TID-17290) ADVANCED TEST REACTOR. AXIAL XENON STABILITY. Study S-R-122. S. W. Spetz (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Nov. 1962. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 50p.

Stability of the Advanced Test Reactor (ATR) with axial xenon oscillations has been calculated using one-dimension analytic methods, digital-computer codes, and analog-computer simulations. It is concluded from these studies that the reference length is stable, but may exhibit an underdamped response to axial flux perturbations. The geometry problems that complicate all ATR nuclear calculations also influence the axial xenon problem. A one-dimension solution of this problem has inherent uncertainties that can be removed only in multidimension calculations. These uncertainties include such factors as proper handling of transverse bucklings and the relationship of the one-dimensional threshold flux to a three-dimensional (real) flux. Xenon stability is a reactor characteristic that cannot be measured reasonably in the critical experiment. There is, therefore, no way to correlate stability calculations with physical reality. Since the potential difficulties associated with xenon instability or underdamped stability are so great, means of detection and control are appropriate. The amount of reactivity required for this purpose is very small. Bare-equivalent threshold lengths are predicted. (auth)

4344 (TID-17308) CLOSED-LOOP ANALOG STUDY FOR THE ADVANCED TEST REACTOR. Study S-R-118. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Sept. 1962. For Ebasco Services, Inc., New York. Contract AT(10-1)-1075. 121p.

An analog computer was used to investigate performance of the Advanced Test Reactor (ATR) and associated control systems. The secondary valve control system was simulated to determine gain settings, stability, and performance. The temperature elements' time constants and locations had to be altered to obtain optimum results. The minimum stop on the secondary throttle valve imposes a reduction in reactor inlet temperature at low powers. To maintain 130°F reactor inlet temperature at a coldwell basin temperature of 85°F, reactor power must be above 5% of full power. When either the reactor power or the coldwell basin temperature is reduced below these values, the reactor inlet temperature drops below 130°F. The primary pressure control system was adequate for all plant transients. Limiting conditions on operation of the degassing system were found for the most severe transients. Analysis of plant transients for summer and winter atmospheric conditions indicated that satisfactory response can be obtained by adjusting controller gains and operating procedures. (auth)

4345 THE RESEARCH REACTOR R2-0 AT STUDSVIK—THE FIRST NUCLEAR REACTOR SUPPLIED BY ASEA. Sigvard Thulin, Peter Hjertberg, and Åke Molin (Nuclear Power Dept., Västeras, Sweden). ASEA (Allmanna Svenska Elektriska Aktiebolaget) J., 35: 117-26 (1962).

The nuclear research reactor R2-0 with a thermal power of 100 kw is used primarily for materials testing. The fuel elements (of enriched uranium) are immersed in a pool of water and are cooled by means of free convection. The control rods are made of cadmium-covered boron carbide. The measuring, control, and regulating equipment is so designed that the reactor is easy to run and reliable in service. (auth)

4346 MECHANICAL AND ELECTRICAL DESCRIPTION AND OPERATION OF THE REACTORS "ARGOS" AND "ARBI". C. Fernández Palomero and L. Álvarez de Buergo (Grupo Reactor Argonaut, Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 4-51(Jan.-Mar. 1962). (In Spanish)

The Argos and Arbi reactors are Argonaut reactors with 10 kw thermal power. They use 20% enriched U as fuel and are moderated by natural water and graphite and have graphite reflectors. Cross sections of the reactors are given. Detailed descriptions and design drawings are given of the reactor construction and safety circuit. (J.S.R.)

4347 THE ELECTRONIC INSTRUMENTATION OF THE "ARGOS" AND "ARBI" REACTORS. Agustin Tanarro Sanz (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 6: 52-70(Jan.-Mar. 1962). (In Spanish)

The measurement, monitoring, and scram devices for the Argos and Arbi reactors are described in some detail. (J.S.R.)

SPACE APPLICATIONS AND TECHNOLOGY

Refer also to abstracts 3659, 3660, 3661, 3811, 3835, 3836, 3837, 3839, 3840, 3852, 3853, 3854, and 3855.

4348 (61SPC3) DESIGN OF A POWER SYSTEM FOR A LUNAR MOBILE SURFACE VEHICLE. R. H. Brody (General Electric Co. Defense Systems Dept., Santa Barbara, Calif.). Oct. 2, 1961. 77p. (AD-273811)

Available power generators are examined to determine which are applicable to a lunar roving vehicle. Two classes of vehicles are of interest: a 300 lb surveyor type vehicle; a 3000 lb prospector type vehicle. It is concluded that a solar cell-battery combination is best and a design is presented for each vehicle, specifying important power system parameters. (auth)

4349 (AD-273676) APPLIED RESEARCH MANAGEMENT ABSTRACT BULLETIN, [BIBLIOGRAPHY ON FLIGHT VEHICLE POWER]. PART I. Abstracts 1-449–1-636. (Aerospace Corp., El Segundo, Calif.). Sept. 1961. Contract AF04(647)-930. 159p. (TDR-930(2701-01)(Pt.I No. 3))

A bibliography, with abstracts, from unclassified literature on flight vehicle power is presented. Selected references on materials are listed. All references are to primary sources. Subject and author indexes are included. (J.R.D.)

4350 (AD-273677) APPLIED RESEARCH MANAGEMENT ABSTRACT BULLETIN, [BIBLIOGRAPHY ON FLIGHT VEHICLE POWER]. PART I. Abstracts 1-961–1-1103. (Aerospace Corp., El Segundo, Calif.). Nov. 1961. Contract AF04(647)-930. 131p. (TDR-930(2701-01)TN-1(Pt.I No. 5))

A bibliography, with abstracts, from unclassified literature on flight vehicle power is presented. Selected references on materials are listed. All references are to primary sources. Subject and author indexes are included. (J.R.D.)

4351 (AD-273678) APPLIED RESEARCH MANAGEMENT ABSTRACT BULLETIN, [BIBLIOGRAPHY ON FLIGHT VEHICLE POWER]. PART I. Abstracts 1-1104–1-1202. (Aerospace Corp., El Segundo, Calif.). Dec. 1961. Contract AF04(647)-930. 93p. (TDR-930(2701-01)TN-1 (Pt.I No. 6))

A bibliography, with abstracts, from unclassified literature on flight vehicle power is presented. Selected references on materials are listed. All references are to primary sources. Subject and author indexes are included. (J.R.D.)

4352 (AD-273692) LOW TEMPERATURE THERMIONIC CONVERTERS. Quarterly Technical Progress Report No. 1, December 1, 1961–March 1, 1962. (Ford Instrument Co., Long Island City, N. Y.). Mar. 1962. Contract AF 33(657)-7663. 17p.

Fabrication and development work performed in the investigation of low temperature thermionic converters are presented. The fabrication work included a high temperature metal-ceramic electron gun envelope, improvement in emitter brazing techniques, and anode cooling techniques. Improved anode temperature uniformity was achieved with a gas cooling loop shaped in the form of a pancake helix. Mo or Cu powder improved the heat transfer between the helix and cup bottom. Cell processing and evaluation data are given as well as results of destructive and shock tests. Techniques for solar and nuclear simulation are discussed. (auth)

4353 (AFSWC-TDR-61-99) NAP-100 THERMOELECTRIC GENERATOR REPORT. G. Spira and T. M. Corry (Westinghouse Electric Corp. New Products Labs., Cheswick, Penna.). Nov. 1961. Contract AF30(602)-1875. 38p. (AD-274280)

The development and performance are presented of a 100-w isotopic fuel, thermoelectric generator designated NAP-100 (Nuclear Auxiliary Power). The generator unit was treated as an integrated system to minimize size and weight without undue sacrifice in efficiency. The 3 basic elements of the generator are: (1) the cold side convective heat exchanger, (2) the thermoelectric couple assembly, and (3) the heat source (an electrical heater which simulated the thermal performance of the nuclear heat source was designed and delivered with the generator). (auth)

4354 (ASD-TR-61-242) UNIQUE PHOTOVOLTAIC CELLS. J. F. Elliott, ed. (General Electric Co. Advanced Semiconductor Lab., Syracuse, N. Y.). July 1961. Contract AF33(616)-7183. 160p. (AD-267519)

Four major areas were investigated in an effort to improve one or more of the following figures of merit to photovoltaic solar energy converters: power output per unit cost, weight, or surface area. Polycrystalline cadmium telluride was investigated as a solar cell material. The work to date has not established any fundamental physical reason why this material should not be useful for this purpose. Attempts to construct a composite cell from a selenium, CdN, or CdSe cell in optical series with a silicon cell did not produce a composite cell with efficiency greater than that of the silicon cell alone. The possibility of using a variable band gap material for a high efficiency converter was examined theoretically. This analysis indicated that the semiconductor materials presently available did not reach a state of development which would permit a useful cell to be constructed. A number of different design considerations for a conventional silicon solar cell were studied. Several of these would apparently make second order improvements in the conversion efficiency. (auth)

4355 (ASD-TR-61-689) TEMPERATURE CONTROL TECHNIQUE FOR SOLAR ENERGY CONVERTERS. Joel K. Baker (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Feb. 1962. Contract AF33(616)-7889. 189p. (AD-274922)

Various active and passive techniques for controlling operating temperatures of solar cells in space were evaluated. Fusion thermal storage, tilting, spacing, and forced convection cooling result in lower temperature operation for nonconcentrating solar arrays, but they offer little system weight reduction. Thermal storage and circulation cooling add considerable complexity. Rankine cycle system studies indicated potential reduced weight-to-power ratios. Work was done on development of improved thermal coatings. Concentrating systems show promise for weight reduction. Adding circulation cooling might further reduce weight, and designs could be used over wide range of solar intensities with little deviation in performance. (auth)

4356 (MND-P-2483-4) SNAP 7 PROGRAM: TASK 8—STRONTIUM-90 FUELED THERMOELECTRIC GENERATOR DEVELOPMENT. Quarterly Progress Report No. 4, August 1, 1961–October 31, 1961. W. S. West (Martin-Marietta Corp. Aerospace Div., Baltimore). Contract AT(30-3)-217. 108p.

Progress during the period includes completion of the SNAP 7C system tests, completion of safety analysis for

the SNAP 7A and C systems, assembly and initial testing of SNAP 7A, assembly of a modified reliability model, and assembly of a 10-W generator. Other activities include completion of thermal and safety analyses for SNAP 7B and D generators and fuel processing for these generators. (J.R.D.)

4357 (MND-P-2679) THERMIONIC ISOTOPIC POWER SYSTEM. Final Summary Report Through September 30, 1961. William E. Kortier and Thomas S. Bustard (Martin-Marietta Corp. Aerospace Div., Baltimore). Contract AT(30-3)-217. 243p.

A summary of research and development in the field of vacuum-diode thermionic energy conversion as it applies to radioisotope-fueled power systems is presented. The development work was done to improve diode performance, to decrease generator weight and size, to develop a radioisotope-fueled generator, and to develop a generator which can withstand missile launch. A generator which can withstand missile launch was developed during the period. A vacuum converter fueled with a radioisotope was developed which provides 2 watts for use in missile applications in space. It is noted that most of the developments associated with the vacuum diode generator are applicable in the CS generator which is under development. (J.R.D.)

4358 (PWA-2100) EXPERIMENTAL INVESTIGATION OF HEAT REJECTION PROBLEMS IN NUCLEAR SPACE POWERPLANTS. Quarterly Report No. 1, June 1–August 31, 1962. H. R. Kunz, H. L. Ornstein, S. S. Wyde, and J. R. Hooper (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract NAS3-2335. 132p.

Data concerning flow distribution and losses in typical header-tube configurations for space radiators are reported. Research is also described concerning the stability of header-condenser tube combinations and the startup and transient operating characteristics of a variety of simulated Rankine cycle space power plants using single-phase and two-phase segmented radiator systems. Work accomplished during the quarter included checkout of the manifold hydrodynamic loss facility and design and procurement of a number of test configurations. Analysis and definition of the condensing stability rings in horizontal flow were completed, and the direct-condensing Rankine loop was constructed except for the heat rejection system. System checkout was initiated. (J.R.D.)

4359 (TID-17306) APPLICATION OF NUCLEAR POWER SUPPLIES TO SPACE SYSTEMS. (Sigma Corp., Los Altos, Calif.). June 30, 1960. For Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Contract AT-11-1-GEN-8. 98p. (LA-3301)

Studies were made to ascertain what useful satellite and/or space missions may be accomplished with the SNAP 2, 8, and 10 power systems within the 1960 to 1970 time period, to delineate useful satellite and/or space missions which would most profitably employ nuclear power sources, to ascertain what restrictions are imposed on various payloads as a result of having a nuclear power system on board, and to investigate the general vehicle integration and installation requirements of the SNAP 2 and 10 power units. Space flight programs, characteristics and limitations of SNAP, applications of nuclear power supplies, design integration, and system integration are discussed. (M.C.G.)

4360 (FTD-TT-61-464) PLASMA ENGINES AND ION AND PHOTON ROCKET ENGINES. V. Kh. Abiants. Translation of p.26-34 from "Reaktivnye Dvigateli i Bol' shie Shorosti" Series IV, 1960 (a publication of Znanie, Moscow, 1960). 13p.

A review of design and operational characteristics of plasma engines is presented along with similar information on ion and photon rocket engines. (J.R.D.)

4361 ELECTRO-PROPULSION WITH COLLOIDS. Stanley Singer and Milton Farber (Rocket Power, Inc., Pasadena, Calif.). Astronautics, 7: No. 1, 34; 36(Jan. 1962).

A brief discussion is presented of factors in electrostatic propulsion favoring an effective development of the use of very small charged particles (colloids) 100 to 1,000,000 times larger than the ions now being used. Such particles appear particularly suited for specific impulses in the intermediate range between present electrothermal devices and ionic propulsion. This intermediate range (1500-6000 sec) is suitable for early interplanetary missions. (H.D.R.)

4362 NUCLEAR ROCKETS FOR UNMANNED MISSIONS. Frank E. Rom, Armin F. Lietzke, and Paul G. Johnson (National Aeronautics and Space Administration, Cleveland). Nucleonics, 20: No. 11, 53-7(Nov. 1962).

Studies were made of the possibility of small nuclear stages for launching unmanned missions from low-lying orbits. Velocity increments required for various space missions from a 300-mile Earth orbit are tabulated. Nuclear-stage requirements are discussed, and it is shown that the required reactor power may be reduced greatly by perigee (intermittent) propulsion. Three reactor types are considered, and it is concluded that the water-moderated reactor with a W^{184} core structure is the most promising. The performance of one- and two-stage chemical and nuclear vehicles is compared for several planned space missions. (D.L.C.)

4363 REPORT ON POWER NEEDS AND NUCLEAR CAPABILITIES. (Atomic Industrial Forum, Inc., Washington, D. C.). Prepublication Copy. 8p.

Conclusions and recommendations adapted by the Special Committee on Communications Satellites are presented. Both low- and high-power systems are considered, and the development of nuclear sources are discussed. Surveys were conducted on power requirements, power sources and capabilities (including non-nuclear), and availability of launch vehicles, and results are summarized. At present, there are no nuclear power systems under specific development for communications satellites. (D.L.C.)

4364 STUDIES OF ION ACCELERATION AND NEUTRALIZATION PROBLEMS USING THE ION ACCELERATOR ANALYSIS COMPUTER PROGRAM. David C. Prince, Jr. and Russell N. Edwards (General Electric Co., Evendale, Ohio). Preprint No. ARS 2401-62. American Rocket Society Electric Propulsion Conference, Berkeley, Calif., Mar. 14-16, 1962. New York, American Rocket Society, 1962. Prepublication Copy. 24p.

The use of the Ion Accelerator Analysis Computer Program developed for studies of problems of ion beam neutralization is described. A simple annular ion beam is found to require extremely good local neutralization if excessive dispersion is to be avoided. Studies show that the interactions of parallel beams of positive and negative ions are not favorable to good mixing without considerable dispersion. (auth)

4365 THE ROLE OF REINFORCED PLASTICS IN FUTURE SPACE VEHICLES. Leo E. Gatzek and C. R. Feller (Aerospace Corp., El Segundo, Calif.). Prepublication Copy. 20p.

The attributes of reinforced plastic composite systems which render these substances indispensable for aerospace applications are reviewed. Examples of molded and filament-wound applications of reinforced plastic systems are presented, and probable means of achieving improvements in these materials commensurate with foreseeable requirements are discussed. The outlined information establishes a factual basis for predicting future space applications of reinforced plastic systems within realistic limits. (auth)

WASTE DISPOSAL AND PROCESSING

Refer also to abstracts 2785, 2810, and 3155.

4366 (HW-69780) BATCH CALCINATION STUDIES—MELT FORMATION. J. J. Shefcik (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 29, 1961. Contract AT(45-1)-1350. 15p.

It is shown that the formation of a meltable calcine by batch calcination of an acidic waste solution containing primary sodium, iron, and aluminum sulfate and nitrate can be predicted. Calcine melting at temperatures less than 900°C can be correlated with the sodium to metal ion ratio and the sulfate to salt nitrate ratio. The minor constituents present in the waste reduce the melt region to some extent. Increasing the pot diameter, using annular pots, or using induction heating had no effect on calcine melting. Near the edge of the melt region, the presence of iron and aluminum have a synergistic effect on calcine melting. The addition of manganese dioxide had no adverse effects on calcine melting but the addition of permanganate did. The addition of calcium ion precluded the formation of a meltable calcine. Meltable calcines could be formed with added phosphate. A fluid calcine could be formed with the addition of phosphate and borate. (auth)

4367 (HW-SA-2629) MANAGEMENT OF RADIOACTIVE EFFLUENT GASES AT HANFORD ATOMIC PRODUCTS OPERATION. J. K. Soldat (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 24, 1962. Contract AT(45-1)-1350. 20p.

Each of the potentially significant sources of radioactive effluent gases at HAPO is controlled through its own particular combination of gas decontamination and stack monitoring. In addition, maximum permissible release guides have been established for the more important sources. The ultimate criteria for derivation of these release guides is limitation of the radiation exposure to persons in the vicinity of the plant to levels below nationally recommended standards. The factors to be considered during derivation of the guides include multiplicity of sources, exposure pathways, and environmental dilution or reconcentration of the radionuclide. Decontamination facilities for chemical separation plants effluent gases include liquid scrubbers, silver nitrate reaction columns, and air filters for process offgases, and large sand or glass wool filter beds for ventilation air exhaust. Stack monitoring equipment measures release rates of radioactive materials and effectiveness of the various decontamination facilities. Evaluation of possible radiation exposures to nearby residents is facilitated through extensive environmental surveillance of air, water, and foodstuff. Comparisons are made between these evaluations and various national and international guides for permissible radiation exposure. (auth)

4368 (IDO-16794) VIBRATIONAL ANALYSIS OF UNFIRED HORIZONTAL BAYONET TUBES IN A FLUIDIZED BED CALCINER. S. D. Anderson and G. W. Hirschi (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Oct. 19, 1962. Contract AT(10-1)-205. 35p.

The heat exchanger of the calciner consists of a vessel into which unfired, horizontal, bayonet tubes extend in a fluidized bed. Strain measurements were taken on several of the tubes under simulated operating conditions and the associated dynamic stresses were calculated. Vibrations greater than design limitations for indefinite operation were found to exist. To restrict these vibrations and prevent further tube fatigue cracking, a tube support was installed. Since the installation of the support, the calciner has operated satisfactorily over 1275 hours. (auth)

4369 (ORO-585) BASIC DATA FROM VEGETATION STUDIES RELATED TO THE MOVEMENT OF RADIOACTIVE WASTES. I. CHEMICAL AND PHYSICAL DATA ON SOILS AND PLANTS OF WHITE OAK LAKE BED, OAK RIDGE, TENNESSEE, 1956–1960. H. R. DeSelm and R. E. Shanks (Tennessee. Univ., Knoxville). Contract AT(40-1)-2077. 95p.

The data organized and presented were accumulated during the first five years after the drainage of White Oak Lake, which was part of the waste disposal system for Oak Ridge National Laboratory. Chemical and physical data include radiochemical, geologic, and ecological properties of soils and plants from the lake bed. (R.J.S.)

4370 (TEI-829) GAMMA-RADIOACTIVITY INVESTIGATIONS RELATED TO WASTE DISPOSAL, JACKASS FLATS, NEVADA TEST SITE. C. M. Bunker and W. A. Bradley (Geological Survey, Washington, D. C.). Sept. 1962. 39p.

Gamma-radiation and density logging studies made during the period Feb. 1959 to Jan. 1961 are described. The studies were concerned with a tile field used for disposal of wash water from decontamination of the Rover-Kiwi facilities after testing. Measurements of background radioactivity made prior to the introduction of waste or material for tracer tests showed no significant increase over the natural radioactivity. Results of the investigation are limited because of small quantities of radioisotopes released to the field thus far. The results of one tracer study indicated that the radioactive material was confined to an area within a few feet of the tile. (J.R.D.)

4371 (TID-16466(Pt.B)) THE STUDY OF THE BEHAVIOR AND SIGNIFICANCE OF CERTAIN RADIOACTIVE ISOTOPES FOUND IN THE SEWAGE TREATMENT PLANTS OF SELECTED CITIES. PART B. STUDY OF SHORT-TERM VARIATIONS AND BEHAVIOR OF CERTAIN GAMMA ACTIVITIES IN THE HYPERION TREATMENT PLANT (1960-1961). Summary of Findings for 1960-1961. T. R. Folsom (Scripps Institution of Oceanography, La Jolla, Calif.) and G. J. Mohanrao (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). May 15, 1962. Contract AT(11-1)-34. 76p. (IMR-TR-922-62-B)

Short-term characteristics of the Hyperion Treatment Plant that can be deduced from following the tags provided by certain gamma emitters in the sewage and sludges are described. Data are given indicating quantitatively the lag in the digesters and in other parts of the system, and further data are given on the partition of cesium between liquid and solid fractions. Examples of trial budgets of tagged flow are given in order to demonstrate the difficulty in following tags in a treatment plant during periods when input concentrations are changing. The possibility of stratification of cesium-137 concentration in sewage channels is investigated, also the possibility of redistribution of cesium-137 by the elutriators before disposal to sea. Measurements are given comparing the different results obtained when radioactivities are sampled hourly, daily, and weekly. A method is described for monitoring sewage essentially continuously, and the effectiveness of this as

compared with methods for assaying samples, both wet and dry. (auth)

4372 (WAPD-T-1280) EVALUATION OF THE PERFORMANCE OF THE RADIOACTIVE WASTE DISPOSAL SYSTEM AT THE SHIPPINGPORT STATION. C. S. Abrams, W. J. Hahn, and J. R. LaPointe (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1961. Contract AT(11-1)-GEN-14. 25p.

Operating data for the radioactive waste disposal system at Shippingport are presented. The plant is described and ultimate disposal of activity is discussed. (M.C.G.)

4373 ENGINEERING GEOLOGY OF RADIOACTIVE WASTE DISPOSAL. Wallace de Laguna (Oak Ridge National Lab., Tenn.). Rev. Eng. Geol., 1: 129-60(1962).

Three possible methods for future waste disposal are now being investigated: fixation in or as solids, disposal into salt, and disposal into deep porous formations. The fixation methods now under investigation all involve heating the waste, are expensive, and are dangerous to the operators, but the solid product once formed would probably be no further hazard. Disposal into salt can be arranged by mining the salt through shafts, which is expensive and will require shaft maintenance. Alternatively, cavities can be dissolved in salt by pumping fresh water down wells, but either such cavities must be small, or their use must be restricted to the disposal of medium-level waste if they are not to overheat. Cavities in salt should provide safe storage, for salt is quite impermeable, but the use of salt as a structural material raises questions. Disposal through deep wells also appears to have serious limitations. The wastes will have to be filtered and diluted and perhaps treated to reduce corrosion of the disposal wells. Heat-generation problems will prevent the disposal of fresh, high-level waste. However, the very large potential storage capacity of deep porous formations suggests that the method may be applicable for the very large amounts of waste that will eventually be produced. Recently an investigation has begun of the possibility of disposing of waste mixtures into shale by fracturing. The subject is controversial, and although the initial experiments look promising it will take much experience with low-level waste before the future of the method can be evaluated. (auth)

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

Æ	becomes	ae
Ø		oe
œ		oe
ü		ue (except in transliterated Chinese names)

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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

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Report No.	Abstract No.	Availability
NUMERICAL	**(Misc.)**	
61SPC3*	17-4348	$7.60(OTS)
AAEC-TM–	**(Australian)**	
155	17-2933	Dep.(mc)
156	17-3062	Dep.(mc)
ACNP–		
6114(Rev.)	17-4293	Dep.(mc); $7.60(fs), $2.33(mf) OTS
62021	17-3063	Dep.(mc); $6.60(fs), $2.30(mf) OTS
62550	17-3366	Dep.(mc); $4.60(fs), $1.52(mf) OTS
AD–	**(Misc.)**	
267519*	17-4354	See ASD-TR-61-242
273451*	17-3141	OTS
273533*	17-3464	See ARA-1029
273540*	17-3562	OTS
273590*	17-4166	See DCAS-TDR-62-10
273624*	17-3380	See ERR-FW-049
273627*	17-3929	OTS
273650*	17-3563	See AFCRL-62-55
273673*	17-2934	$8.60(OTS)
273676*	17-4349	OTS
273677*	17-4350	OTS
273678*	17-4351	OTS
273692*	17-4352	$3.60(OTS)
273694*	17-4168	See GCA-TR-62-4-A
273697*	17-3962	See AFOSR-2390
273793*	17-3374	See ARL-230
273802*	17-3460	$9.10(OTS)
273811*	17-4348	See 61SPC3
273895*	17-3461	$3.60(OTS)
273999*	17-3567	See AFCRL-851
274000*	17-2935	$1.60(OTS)
274014*	17-4164	See AFCRL-62-91
274106*	17-3142	$8.60(OTS)
274126*	17-4175	See RADC-TDR-62-87
274204*	17-3468	See ASD-TR-62-7-675
274228*	17-2660	See BRL-Memo-1390
274250*	17-3565	See AFCRL-62-255
274266*	17-4162	$7.60(OTS)
274272*	17-3566	See AFCRL-62-419
274280*	17-4353	See AFSWC-TDR-61-99
274313*	17-4239	See JPL-TR-32-188
274338*	17-2823	See RADC-TDR-62-102
274477*	17-3144	See AFSWC-TDR-62-35
274599*	17-3908	See RM-3096-PR
274636*	17-2906	See WAL-TR-823/3
274637*	17-2907	See WAL-TR-823.5/1
274700*	17-4167	See DCAS-TDR-62-46
274727L*	17-2656	
274759*	17-4049	See AFOSR-2531
274825*	17-2658	See AFSWC-TDR-61-93
274922*	17-4355	See ASD-TR-61-689
274948*	17-3564	See AFCRL-62-142
275015*	17-4163	$4.60(OTS)
275092*	17-3367	$14.00(OTS)
275111*	17-3466	See ASD-TR-61-351
275139*	17-3301	$2.60(OTS)
275281*	17-4170	See ML-900
275379*	17-3467	See ASD-TR-61-474
275462*	17-3104	$3.60(OTS)
275571*	17-3368	$2.25(OTS)
275605*	17-2815	
275905*	17-3201	Dep.(mc)
275938*	17-3462	$1.60(OTS)
275962*	17-3442	See ERR-FW-064
276008*	17-3441	See ERR-FW-043
276049*	17-2816	
276060*	17-4169	See MIT-28-T-P
276062*	17-3303	See AFOSR-2669
276079*	17-3302	
276084*	17-3369	$3.60(OTS)
276118*	17-2936	$3.60(OTS)
276185*	17-3143	$4.60(OTS)
276290*	17-2659	See AFSWC-TR-61-90
276381*	17-3370	$10.50(OTS)
276392*	17-2657	$9.10(OTS)
276408*	17-3375	See ASD-TR-7-826(II)
276411*	17-3463	$8.10(OTS)
276451*	17-3256	$12.50(OTS)
276709*	17-3390	See WADC-TR-53-373(Suppl.8)
276748*	17-3372	See AFCRL-62-315
277459*	17-3437	$8.10(fs) OTS
278658*	17-3573	See NP-12206
282403*	17-3540	See NP-12257
286453*	17-3438	See ARF-2220-18
286982*	17-3481	See NP-12198
287088*	17-2824	See SAM-TDR-62-77
287434*	17-3445	See NP-12225
287623*	17-3234	See USNRDL-TR-585
287849*	17-3931	See AFCRL-1089
287900*	17-3427	See NP-12233
287947*	17-3930	See AFCRL-62-652
288146*	17-3485	See RAD-SR-62-219
288233*	17-3439	See ASD-TR-7-532a(VIII)
288808*	17-3153	See NP-12277
288859*	17-3151	See NP-12275
288861*	17-3152	See NP-12276
288904*	17-3483	See NP-12253
288948*	17-3154	See NP-12278
289567L*	17-4210	See DASA-1318
289869*	17-3315	See USNRDL-TR-586
292674*	17-3574	See NP-12212
AEC-tr–		
5080	17-3276	Dep.; $4.50(OTS)
5264	17-2959	Dep.; $2.25(OTS)
5377	17-3028	Dep.; $1.75(OTS)
5524	17-4182	Dep.(mc); $2.60(fs), $0.83(mf) JCL or OTS
AECL–	**(Canadian)**	
1564	17-4027	Can. J. Phys. 40: 1254-8(1962)
1567	17-4230	See DL-51
1626	17-3472	See CRGM-1081
1637	17-4229	See CRRP-1116
1641	17-2937	Dep.; $0.50(AECL)
AECL-HP–	**(Pakistan)**	
1	17-3210	See NP-12227
AEET/AM–	**(Indian)**	
26	17-2808	Dep.(mc)
AEEW-R–	**(British)**	
57	17-4076	J. Nucl. Energy Pt. A and B, 16: 335-50 (1962)
AER-EIR–	**(Non-AEC)**	
13623	17-3256	See AD-276451
AERE-M–	**(British)**	
M-164	17-3371	Dep.(mc)
AERE-R–	**(British)**	
3896	17-3516	J. Nucl. Energy Pt. A and B, 16: 369-73(1962)
3999	17-3330	Nuclear Instr. & Methods 16: 284-5 (1962)
AFCRL–	**(Misc.)**	
62-55*	17-3563	$1.60(OTS)

Report No.	Abstract No.	Availability
62-91*	17-4164	$9.10(OTS)
62-142*	17-3564	$5.60(OTS)
62-164*	17-4170	See ML-900
62-251(II)	17-3148	See HW-71400(Vol.2)
62-255*	17-3565	$5.60(OTS)
62-315*	17-3372	$2.25(OTS)
62-419*	17-3566	$3.60(OTS)
62-652*	17-3930	$2.60(OTS)
851*	17-3567	$3.60(OTS)
1089*	17-3931	$8.10(OTS)
AFOSR–	**(Misc.)**	
2167*	17-2935	See AD-274000
2390*	17-3962	$2.60(OTS)
2531*	17-4049	$2.60(OTS)
2669*	17-3303	$1.60(OTS)
AFSWC-TDR–	**(Non-AEC)**	
61-93	17-2658	$28.50(fs) OTS
61-99	17-4353	$4.60(OTS)
62-11(Vol.II)	17-4168	See GCA-TR-62-4-A
62-35	17-3144	OTS
AFSWC-TR–	**(Non-AEC)**	
61-90	17-2659	$7.60(OTS)
ANL–		
6319(Rev.)	17-3353	Dep.; $1.25(OTS)
6551	17-4050	Dep.; $0.75(OTS)
6592	17-3568	Dep.; $0.50(OTS)
6629	17-4294	Dep.; $2.25(OTS)
6635	17-4222	Dep.; $1.50(OTS)
ANL-FGF–		
318	17-2938	Dep.(mc); $1.60(fs), $0.80(mf) OTS
384	17-3417	
APAE-Memo–	**(Misc.)**	
248	17-3418	Dep.(mc); $3.60(fs), $1.34(mf) OTS
ARA–	**(Non-AEC)**	
1029	17-3464	$7.60(OTS)
ARF–	**(Misc.)**	
2152-18*	17-3419	OTS
2220-18*	17-3438	$4.60(fs) OTS
ARL–	**(Non-AEC)**	
62-416	17-3373	$2.75(OTS)
62-426	17-3020	$3.00(OTS)
230	17-3374	$2.60(OTS)
ASD-TDR–	**(Non-AEC)**	
62-594	17-3465	OTS
62-707	17-3569	OTS
ASD-TR–	**(Non-AEC)**	
7-532a(VIII)	17-3439	$8.10(OTS)
7-826(II)	17-3375	$2.60(OTS)
7-886(VI)	17-3438	See ARF-2220-18
61-242	17-4354	$3.00(OTS)
61-351	17-3466	$2.50(OTS)
61-474	17-3467	$2.75(OTS)
61-689	17-4355	$3.00(OTS)
61-692	17-3084	$7.00(OTS)
61-723	17-3570	OTS
62-7-675	17-3468	$17.00(OTS)
ASRCE-TM–	**(Non-AEC)**	
62-7	17-3376	

Report No.	Abstract No.	Availability
AST-EIR–	**(Non-AEC)**	
13533	17-3482	See NP-12224
ATRCE–		
100	17-4339	See TID-17270
101	17-4338	See TID-17268
102	17-4340	See TID-17271
103	17-4341	See TID-17281
105	17-4342	See TID-17282
AWRE-Lib.–	**(British)**	
5	17-3304	Dep.(mc)
6	17-3377	Dep.(mc)
9	17-2894	Dep.(mc)
AWRE-Trans–	**(British)**	
32	17-3118	Dep.(mc); $2.60(fs), $0.89(mf) JCL or OTS
33	17-3075	Dep.(mc); $1.60(fs), $0.85(mf) JCL or OTS
BC–	**(Misc.)**	
21*	17-3206	See HMI-B-23
BLG–	**(Belgian)**	
103	17-2782	Dep.(mc)
124	17-3420	Dep.(mc)
BM-RI–	**(Misc.)**	
6101	17-3469	Free(Bureau of Mines)
BMI–	**(Misc.)**	
1583(Del.)	17-3378	Dep.; $2.00(OTS)
1596(Del.)	17-3379	Dep.; $2.00(OTS)
1601	17-3470	Dep.; $1.00(OTS)
1602	17-3440	Dep.; $0.50(OTS)
BMI-X–		
10017	17-3471	Dep.(mc); $1.60(fs), $0.80(mf) OTS
BNL–		
5454	17-3021	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5458	17-3011	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5521	17-2902	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5554	17-3145	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5574	17-3421	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5615	17-3105	Dep.(mc); $4.60(fs), $1.43(mf) OTS
5628	17-2903	$1.60(fs), $0.80(mf) OTS
5974	17-3202	Dep.(mc); $2.60(fs), $0.95(mf) OTS
5989	17-2817	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6000	17-3146	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6001	17-3203	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6012	17-3394	J. Nucl. Mater. 6: 334-5(1962)
6064	17-4159	Rev. Sci. Instr. 33: 919-21(1962)
6100	17-3018	J. Phys. Chem. 66: 2262-4(1962)
6114	17-2985	J. Phys. Chem. 66: 2192-2200(1962)
6143	17-4071	Can. J. Phys. 40: 1249-51(1962)
6270	17-4098	Phys. Rev. 128: 2392-7(1962)
6292	17-3890	Trans. Am. Nucl. Soc. 5: 477(1962)
6293	17-2774	p.293-7 of Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962
6342	17-2818	Dep.(mc); $4.60(fs), $1.58(mf) OTS
6362	17-2783	Dep.(mc); $2.60(fs), $0.95(mf) OTS
6407	17-3022	Proceedings of the IAEA Seminar on the Practical Applications of Short-Lived Radioisotopes Produced in Small Research Reactors, Vienna, November 5–9, 1962
6466	17-2819	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6467	17-2820	Dep.(mc); $2.60(fs), $1.07(mf) OTS
6510	17-3023	Dep.(mc); $5.60(fs), $1.88(mf) OTS
6512	17-4120	Dep.(mc); $14.00(fs), $6.44(mf) OTS

Report No.	Abstract No.	Availability
BRL-Memo–		
1390*	17-2660	$9.10(OTS)
BSC–	**(Misc.)**	
29556*	17-3562	See AD-273540
31975*	17-3540	See NP-12257
CEA–	**(French)**	
2144	17-3147	Dep.(mc)
2164	17-3204	Dep.(mc)
2193	17-4228	Dep.(mc)
CEA-Bib.–	**(French)**	
22	17-2809	Dep.(mc)
CEA-tr–	**(French)**	
X-468	17-3350	Dep.(mc); $2.60(fs), $0.98(mf) JCL
CERN-FSG–	**(European Organization for Nuclear Research)**	
15	17-4165	Dep.(mc)
CM–	**(Misc.)**	
1011*	17-3104	See AD-275462
CRGM–	**(Canadian)**	
1081	17-3472	Dep.; $1.00(AECL)
CRRP–	**(Canadian)**	
1116	17-4229	Dep.; $2.00(AECL)
CVC–	**(Non-AEC)**	
2-53420/2R375	17-3460	See AD-273802
DASA–	**(Misc.)**	
1273*	17-2660	See BRL-Memo-1390
1318*	17-4210	
DCAS-TDR–	**(Non-AEC)**	
62-10	17-4166	$1.60(fs) OTS
62-46	17-4167	$1.60(fs) OTS
DL–	**(Non-AEC)**	
51	17-4230	Dep.; $1.00(AECL)
DP–		
370	17-3064	Dep.; $0.50(OTS)
694	17-3422	Dep.; $0.50(OTS)
740	17-4295	Dep.; $0.50(OTS)
749	17-3473	Dep.; $0.50(OTS)
758	17-4231	Dep.; $0.75(OTS)
778	17-4232	Dep.; $1.25(OTS)
783	17-3205	Dep.; $0.50(OTS)
787	17-4296	Dep.; $2.00(OTS)
DPSPU–		
62-30-38	17-3474	Dep.(mc); $5.60(fs), $1.88(mf) OTS
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EOS–	**(Non-AEC)**	
3000-Q-2	17-3573	See NP-12206
ERR-FW–	**(Non-AEC)**	
043	17-3441	$1.00(OTS)
049	17-3380	
064	17-3442	$2.60(OTS)
EURAEC–		
383	17-2909	Dep.(mc); $6.60(fs), $2.03(mf) OTS
429	17-3391	Dep.(mc); $1.60(fs), $0.80(mf) OTS
453	17-3063	See ACNP-62021
468	17-3471	See BMI-X-10017
FTD-TT–	**(Non-AEC)**	
61-396	17-2668	OTS
61-464	17-4360	OTS
62-99	17-3910	OTS
GA–	**(Misc.)**	
2166	17-3520	Mater. Res. Std. 2: 275-7(1962)
2301	17-4233	Dep.; $1.25(OTS)
2903	17-4201	Phys. Fluids 5: 1076-80(1962)
2998	17-3423	Dep.(mc); $3.60(fs), $1.22(mf) OTS
3539	17-4297	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GAMD–	**(Misc.)**	
2729	17-3475	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GCA-TR–	**(Non-AEC)**	
62-4-A	17-4168	$18.00(fs) OTS
GEMP–		
17A	17-3381	Dep.; $1.25(OTS)
HMI-B–	**(German)**	
23	17-3206	Dep.(mc)
HPR–	**(Norwegian)**	
26	17-4298	Dep.(mc)
HW–		
48861TH	17-4234	Dep.(mc); $8.10(fs), $2.84(mf) OTS
52755	17-3065	Dep.(mc); $1.10(fs), $0.80(mf) OTS
63501	17-3056	
67717	17-2939	Dep.(mc); $2.60(fs), $1.01(mf) OTS
68069(Rev.)	17-3305	Dep.(mc); $1.60(fs), $0.80(mf) OTS
69780	17-4366	$1.60(fs), $0.80(mf) OTS
71251	17-4329	Dep.(mc); $1.60(fs), $0.80(mf) OTS
71400(Vol.2)	17-3148	Dep.; $4.00(OTS)
71521	17-4235	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73013	17-4236	$3.60(fs), $1.16(mf) OTS
74287	17-4237	Dep.; $0.50(OTS)
75051	17-3066	Dep.(mc); $1.10(fs), $0.80(mf) OTS
75052	17-3537	Dep.; $0.75(OTS)
75125	17-3476	Dep.; $0.50(OTS)
HW-SA–		
2175	17-2940	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2246	17-3067	Dep.(mc); $2.60(fs), $0.83(mf) OTS
2290	17-3068	Dep.(mc); $2.60(fs), $1.01(mf) OTS
2343	17-2896	Am. Mineralogist 47: 1067-78(1962)
2497	17-3538	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2568	17-3290	Rev. Sci. Instr. 33: 1079-81(1962)
2629	17-4367	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2689	17-3443	Dep.(mc); $3.60(fs), $1.37(mf) OTS
2700	17-2796	Dep.(mc); $3.60(fs), $1.16(mf) OTS
2751	17-3263	Dep.(mc); $2.60(fs), $0.83(mf) OTS
2763	17-2797	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2764	17-2798	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2785	17-3207	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2800	17-2821	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2801	17-3134	Dep.(mc); $2.60(fs), $1.10(mf) OTS
2805	17-3539	Dep.(mc); $1.10(fs), $0.80(mf) OTS
IA–	**(Non-AEC)**	
742	17-3012	Dep.(mc)
771	17-3571	Dep.(mc)
773	17-3963	Dep.(mc)
IDO–		
14541	17-3085	Dep.; $1.60(fs), $0.80(mf) OTS

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16781	17-4330	Dep.; $2.00(OTS)
16794	17-4368	Dep.; $0.75(OTS)
16799	17-4238	Dep.; $2.50(OTS)
16805	17-4331	Dep.; $1.50(OTS)
IMR-TR-		
922-62-B	17-4371	See TID-16466(Pt.B)
IS-		
316	17-3477	Dep.(mc); $2.60(fs), $0.98(mf) OTS
359	17-2941	Dep.(mc); $6.60(fs), $2.12(mf) OTS
407	17-2974	Inorg. Chem. 1: 955-6(1962)
416	17-2982	J. Phys. Chem. 66: 2114-16(1962)
489	17-2994	Phys. Rev. Letters 9: 255-7(1962)
492	17-3106	Dep.; $1.00(OTS)
JAERI-	**(Japanese)**	
6011	17-2661	
JINR-	**(Russian)**	
E-1064	17-4051	Dep.(mc)
P-1040	17-3964	Dep.(mc)
P-1070	17-4052	Dep.(mc)
JPL-TR-	**(Non-AEC)**	
32-188	17-4239	
32-269	17-3107	
32-297	17-3478	
JPRS-	**(Non-AEC)**	
16059	17-3500	OTS
16063	17-3392	$2.60(fs) OTS
16496	17-2803	OTS
K-		
1531	17-3108	Dep.; $2.50(OTS)
1533	17-2942	Dep.; $0.50(OTS)
1549	17-3109	Dep.; $0.50(OTS)
KAPL-		
2225	17-4023	Dep.; $1.25(OTS)
KAPL-M-		
BM-2	17-4053	Dep.(mc); $6.60(fs), $2.09(mf) OTS
CHR-6	17-3354	Dep.(mc); $7.60(fs), $2.57(mf) OTS
EC-26	17-4240	Dep.(mc); $2.60(fs), $0.83(mf) OTS
EIB-1	17-4024	Dep.(mc); $6.60(fs), $2.24(mf) OTS
MCR-2	17-3355	Dep.(mc); $1.60(fs), $0.80(mf) OTS
RXH-1	17-3444	Dep.(mc); $1.10(fs), $0.80(mf) OTS
WBI-1	17-3356	Dep.(mc); $2.60(fs), $0.98(mf) OTS
WKA-16	17-3424	Dep.(mc); $4.60(fs), $1.43(mf) OTS
LA-		
3301	17-4359	See TID-17306
LADC-		
2055	17-3536	p.281-308 of "The Metal Plutonium." Chicago, University of Chicago, 1961
2963	17-3534	p.210-24 of "The Metal Plutonium." Chicago, University of Chicago, 1961
3090	17-3533	p.157-82 of "The Metal Plutonium." Chicago, University of Chicago, 1961
3119	17-3397	p.36-62 of "The Metal Plutonium." Chicago, University of Chicago, 1961
3767	17-3535	p.265-80 of "The Metal Plutonium." Chicago, University of Chicago, 1961
4369(Rev.2)	17-3069	Dep.(mc); $2.60(fs), $1.04(mf) OTS
4969	17-3489	See TID-14497
4981	17-3909	See TID-13994
4987	17-3279	4p. of Instr. Control Systems, [35]: (1962)

Report No.	Abstract No.	Availability
5133	17-3386	See TID-14534
5207	17-2877	See TID-14791
5409	17-2979	Inorg. Chem. 1: 975(1962)
5427	17-3306	Dep.(mc); $2.60(fs), $0.89(mf) OTS
5436	17-3785	Trans. Am. Nucl. Soc. 5: 381-2(1962)
5442	17-2749	p.55-62 of Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962
5446	17-2799	Dep.(mc); $4.60(fs), $1.52(mf) OTS
LAMS-		
2674(Pt.II)	17-3479	Dep.; $6.60(fs), $2.27(mf) OTS
2755	17-4336	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2760	17-3149	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2764	17-3307	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2770	17-3572	Dep.; $0.50(OTS)
2773	17-3480	Dep.; $0.50(OTS)
LAS-SR-		
161-51	17-3259	See TID-17024
LS-	**(Israeli)**	
118	17-4241	Dep.(mc)
MATT-		
128	17-3096	Rev. Sci. Instr. 33: 985-6(1962)
MBL-	**(Dutch)**	
1961/9	17-3201	See AD-275905
MIT-	**(Misc.)**	
28-T-P*	17-4169	$9.10(OTS)
ML-	**(Misc.)**	
900*	17-4170	$11.50(OTS)
MLM-		
1135	17-2662	Dep.; $0.50(OTS)
MND-M-	**(Misc.)**	
1825	17-4299	Dep.(mc); $8.10(fs), $2.75(mf) OTS
MND-MD-		
2542	17-3110	Dep.(mc); $15.00(fs), $6.86(mf) OTS
MND-P-		
2483-4	17-4356	Dep.(mc); $9.10(fs), $3.44(mf) OTS
2679	17-4357	Dep.(mc); $16.00(fs), $7.49(mf) OTS
MPR-XIII-		
9-62	17-3116	See TID-16972
MRC-	**(Misc.)**	
61-625*	17-2822	See NP-12173
MSAR-	**(Misc.)**	
62-126	17-3425	Dep.(mc); $4.60(fs), $1.43(mf) OTS
MSUCP-		
8	17-3357	Dep.(mc); $3.60(fs), $1.28(mf) OTS
MTI-	**(Misc.)**	
62TR-20*	17-3427	See NP-12233
MURA-	**(Misc.)**	
649	17-4149	Dep.; $2.75(OTS)
NAA-SR-		
6403	17-4300	Dep.; $1.25(OTS)
7400	17-4242	Dep.; $6.00(OTS)
7650	17-3208	Dep.; $0.75(OTS)

Report No.	Abstract No.	Availability
NASA-TN–	**(Misc.)**	
D-1440*	17-3111	$1.00(OTS)
NBS–	**(Misc.)**	
7280	17-4171	Dep.(mc); $2.60(fs), $0.86(mf) OTS
NBS-MON–	**(Misc.)**	
42	17-2734	$0.75(GPO)
NBS-TN–	**(Non-AEC)**	
122	17-3112	$1.25(OTS)
NIRL-R–	**(British)**	
19	17-3086	Dep.(mc); $0.77(BIS); 5s. 6d. HMSO
NLCO–		
859	17-2943	Dep.; $0.50(OTS)
NMI–	**(Misc.)**	
9522*	17-3382	
NP–	**(AEC File No. for Non-AEC Reports)**	
10458(Vol.8)	17-4301	Dep.(mc); $8.60(fs), $2.99(mf) OTS
11563	17-3257	Dep.; $2.00(OTS)
12173	17-2822	
12186	17-3209	Dep.(mc)
12188	17-4054	Dep.(mc)
12189	17-3426	
12194	17-3150	
12198	17-3481	$2.60(OTS)
12201	17-4055	Dep.(mc)
12203	17-4172	
12204	17-4056	Dep.(mc)
12206	17-3573	$3.60(OTS)
12210	17-2663	Dep.(mc)
12212	17-3574	$9.10(fs) OTS
12224	17-3482	
12225	17-3445	$4.60(OTS)
12226	17-3308	
12227	17-3210	Dep.(mc)
12230	17-4173	Dep.(mc)
12233	17-3427	$4.60(OTS)
12247(Pt.A)	17-4057	
12247(Pt.B)	17-4058	
12253	17-3483	$3.60(fs) OTS
12254	17-4059	
12256	17-3446	OTS
12257	17-3540	$5.60(fs) OTS
12262	17-3965	Dep.(mc)
12263	17-3966	Dep.(mc)
12265	17-3309	
12275	17-3151	
12276	17-3152	
12277	17-3153	
12278	17-3154	
12305	17-3484	
12312	17-3575	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
924	17-3450	Dep.(mc); $1.10(fs), $0.80(mf) JCL
926	17-3544	Dep.(mc); $1.60(fs), $0.83(mf) JCL
NPCC-NWP–	**(British)**	
(S)-DGD/P-36	17-3269	See TRG-Report-374
NRC–	**(Canadian)**	
6934	17-3932	Can. J. Phys. 40: 1049-55(1962)
6937	17-4187	Can. J. Phys. 40: 1251-3(1962)
6942	17-2964	Can. J. Phys. 40: 1274-5(1962)
NUMEC-P–		
48	17-3383	Dep.(mc); $1.10(fs), $0.80(mf) OTS
102	17-3384	Dep.(mc); $5.60(fs), $1.76(mf) OTS
NYO–		
8102	17-3211	Dep.(mc); $8.60(fs), $3.05(mf) OTS
9765	17-4060	Dep.(mc); $3.60(fs), $1.31(mf) OTS
9803	17-2944	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9872	17-2895	Dep.(mc); $3.60(fs), $1.31(mf) OTS
10095	17-4250	Dep.(mc); $2.60(fs), $0.92(mf) OTS
10143	17-3024	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10411	17-3258	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORA–	**(Misc.)**	
4386-2-F*	17-4164	See AFCRL-62-91
03763-9-P	17-4150	See TID-17065
ORNL–		
3090	17-3310	Dep.; $0.50(OTS)
3293	17-2945	Dep.; $8.60(fs), $3.14(mf) OTS
3318	17-3358	Dep.(mc); $1.25(OTS)
3330	17-4025	Dep.; $2.60(fs), $0.89(mf) OTS
3334	17-2664	Dep.; $0.50(OTS)
3344	17-3264	Dep.; $1.00(OTS)
3347	17-2784	Dep.; $2.75(OTS)
3370	17-2810	Dep.; $2.50(OTS)
ORNL-TM–		
166	17-3135	Dep.(mc); $2.60(fs), $1.10(mf) OTS
218	17-4251	Dep.(mc); $2.60(fs), $0.83(mf) OTS
265	17-3070	Dep.(mc); $7.60(fs), $2.51(mf) OTS
380	17-4337	Dep.(mc); $2.60(fs), $0.95(mf) OTS
389	17-3113	Dep.(mc); $3.60(fs), $1.31(mf) OTS
397	17-4252	Dep.(mc); $2.60(fs), $0.98(mf) OTS
399	17-3576	Dep.(mc); $1.60(fs), $0.80(mf) OTS
417	17-3428	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORO–		
585	17-4369	Dep.; $2.00(OTS)
PATENTS	**(German)**	
1,018,777	17-3450	See NP-tr-924
1,122,182	17-4209	
1,126,039	17-4286	
1,127,005	17-4287	
1,127,507	17-4288	
1,128,573	17-4325	
1,130,529	17-3347	
1,130,941	17-4326	
1,131,334	17-3019	
1,136,026	17-4289	
1,136,635	17-3100	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
2,063,829	17-3060	
3,061,483	17-3436	
3,061,530	17-3561	
3,061,531	17-3055	
3,061,532	17-4290	
3,061,533	17-4327	
3,061,722	17-3139	
3,061,724	17-3348	
3,061,725	17-3199	
3,061,728	17-3200	
3,063,005	17-3101	
3,063,290	17-3140	
3,063,291	17-3102	
3,063,792	17-3061	
3,063,793	17-3458	
3,063,794	17-3416	
3,063,830	17-3082	
3,063,925	17-4291	

Report No.	Abstract No.	Availability
3,063,926	17-4328	
3,063,927	17-4292	
3,064,063	17-3103	
3,064,064	17-3300	
3,064,130	17-3349	
3,065,044	17-3083	
3,065,537	17-3459	
PB–	**(Non-AEC)**	
161623	17-3112	See NBS-TN-122
181324	17-3084	See ASD-TR-61-692
PG-Report–	**(British)**	
354	17-3265	Dep.; $0.56(BIS); 4s.(HMSO)
374	17-2904	Dep.
PHE–		
115F	17-2665	Dep.; $1.25(OTS)
PPAD–		
454E	17-3311	Dep.(mc); $1.10(fs), $0.80(mf) OTS
465D	17-3312	Dep.(mc); $3.60(fs), $1.34(mf) OTS
473E	17-3359	Dep.(mc); $2.60(fs), $0.95(mf) OTS
PPL-TR–	**(Non-AEC)**	
62-16	17-4174	
PRDC-TR–		
58	17-4253	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PREDC–		
759	17-3447	Dep.(mc); $15.00(fs), $6.89(mf) OTS
PRL–	**(Non-AEC)**	
9-24	17-4172	See NP-12203
PUC–		
1962-73	17-3927	Phys. Rev. 128: 2006-11(1962)
1962-88	17-4061	Dep.(mc); $2.60(fs), $1.04(mf) OTS
PWA–	**(Non-AEC)**	
2100	17-4358	
R–	**(Misc.)**	
3202-3*	17-3426	See NP-12189
RAD-SR–	**(Non-AEC)**	
62-219	17-3485	$1.60(OTS)
RADC-TDR–		
62-87	17-4175	$6.60(OTS)
62-102	17-2823	Dep.(mc); $2.60(OTS)
RC–	**(Misc.)**	
196*	17-3372	See AFCRL-62-315
RDB(S)	**(British)**	
TM-3303	17-3486	
RFP–		
278	17-3025	Dep.(mc); $1.60(fs), $0.80(mf) OTS
279	17-2905	Dep.(mc); $1.60(fs), $0.80(mf) OTS
RISO–	**(Danish)**	
49	17-4302	Dep.(mc)
RM–	**(Misc.)**	
3096-PR*	17-3908	$3.60(fs) OTS
RPD–	**(Canadian)**	
12	17-3209	See NP-12186

Report No.	Abstract No.	Availability
SAM-TDR–	**(Non-AEC)**	
62-77	17-2824	$1.10(OTS)
SC–	**(Misc.)**	
4459(RR)	17-4303	Dep.(mc); $4.60(fs), $1.55(mf) OTS
SCDC–		
2623	17-3094	Rev. Sci. Instr. 33: 914-15(1962)
2911	17-3542	See TID-17351
SCR–		
314	17-3360	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SCTM–		
71-61(54)	17-3361	Dep.(mc); $5.60(fs), $1.94(mf) OTS
SEP–		
260	17-3487	Dep.; $0.50(OTS)
SL–	**(Misc.)**	
1974-2	17-4304	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SMIR–	**(Non-AEC)**	
62-5	17-3370	See AD-276381
SRO–		
74	17-4305	Dep.(mc); $1.60(fs), $0.80(mf) OTS
STI-DOC–	**(International Atomic Energy Agency)**	
10/10	17-2875	$1.00(IAEA)
TDR–	**(Non-AEC)**	
930(2119)TR-2	17-2934	See AD-273673
930(2210-02)TN-1	17-4167	See DCAS-TDR-62-46
930(2230-03)TN-2	17-4166	See DCAS-TDR-62-10
930(2701-01)TN-1 Pt.I,No.3	17-4349	See AD-273676
930(2701-01)TN-1 Pt.I,No.5	17-4350	See AD-273677
930(2701-01)TN-1 Pt.I,No.6	17-4351	See AD-273678
TEI–		
823	17-3155	Dep.(mc); $8.60(fs), $3.02(mf) OTS
829	17-4370	Dep.(mc); $3.60(fs), $1.37(mf) OTS
832	17-3156	Dep.(mc); $6.60(fs), $2.24(mf) OTS
TID–		
3525(Rev.4)	17-3212	Dep.; $2.25(OTS)
3909(Suppl.)	17-2825	Dep.; $0.75(OTS)
4100(1st Rev., Suppl.16)	17-3087	Free (DTI Extension)
7635	17-3213	Dep.; $2.75(OTS)
8212	17-3385	Dep.; $1.00(OTS)
12778	17-4045	p.195-214 of "Neutron Physics." New York, Academic Press, 1962
13242	17-2932	p.233-47 of "Developments in Applied Spectroscopy. Volume 1." New York, Plenum Press, 1962
13276	17-3114	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13814	17-2946	Dep.(mc); $1.10(fs), $0.80(mf) OTS
13994	17-3909	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14059	17-4062	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14073	17-4026	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14150	17-3266	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14151	17-2800	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14175	17-3488	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14354	17-3115	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14497	17-3489	Dep.(mc); $3.60(fs), $1.25(mf) OTS
14534	17-3386	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14681	17-3490	Dep.(mc); $1.60(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
14791	17-2877	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14840	17-3985	Phys. Rev. 128: 2398-2402(1962)
14889	17-3448	Dep.(nc); $1.10(fs), $0.80(mf) OTS
14891	17-3071	Dep.(nc); $3.60(fs), $1.16(mf) OTS
15452	17-3136	Dep.(nc); $1.60(fs), $0.80(mf) OTS
15459	17-3267	Dep.(nc); $2.60(fs), $0.83(mf) OTS
15797	17-3609	Phys. Chem. Solids 23: 1671-7(1962)
15855	17-2983	J. Phys. Chem. 66: 2159-64(1962)
16213	17-2746	p.39-44 of Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962
16466(Pt.B)	17-4371	Dep.; $2.50(OTS)
16551	17-3223	See TID-7635(p.112-15)
16736	17-3704	Trans. Am. Nucl. Soc. 5: 308(1962)
16764	17-3228	Dep.; $0.75(OTS)
16872	17-3626	Phys. Rev. 128: 2207-18(1962)
16972	17-3116	Dep.(nc); $2.60(fs), $0.86(mf) OTS
16988	17-3157	Dep.(nc); $13.00(fs), $5.87(mf) OTS
17024	17-3259	Dep.(nc); $3.60(fs), $1.19(mf) OTS
17025	17-3229	Dep.(nc); $9.60(fs), $3.65(mf) OTS
17045	17-2811	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17048	17-2826	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17065	17-4150	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17067	17-3577	Dep.(nc); $6.60(fs), $2.06(mf) OTS
17084	17-3253	For presentation at AIChE Symposium on Nuclear Safety in Handling Radioactive Fuels, Chicago, Dec. 3-6, 1962.
17087	17-3165	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17090	17-3166	Dep.; $0.50(OTS)
17116	17-2876	The Proceedings of the 44th Annual Meeting of the Federation of American Societies for Experimental Biology, April 11–17, 1960.
17168	17-3578	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17169	17-2827	Dep.(nc); $3.60(fs), $1.19(mf) OTS
17170	17-2828	Dep.(nc); $2.60(fs), $0.92(mf) OTS
17171	17-2829	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17189	17-2830	Dep.(nc); $7.60(fs), $2.39(mf) OTS
17191	17-2801	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17197	17-4176	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17198	17-2831	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17200	17-2802	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17201	17-2832	$5.60(fs), $1.88(mf) OTS
17203	17-2947	Dep.(nc); $3.60(fs), $1.22(mf) OTS
17211	17-3541	Dep.(nc); $3.60(fs), $1.40(mf) OTS
17216	17-2948	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17218	17-2949	Dep.(nc); $4.60(fs), $1.70(mf) OTS
17224	17-3167	Dep.(nc); $2.50(OTS)
17224(Suppl.)	17-3168	Dep.(nc); $3.00(OTS)
17225	17-2833	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17228	17-4151	Nucl. Instr. Methods, 18, 19: 343-5(1962)
17229	17-2812	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17231	17-4306	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17240	17-3959	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17246	17-4152	Nucl. Instr. Methods, 18, 19: 378-86(1962)
17247	17-4153	Nucl. Instr. Methods, 18, 19: 281-93(1962)
17248	17-4154	Nucl. Instr. Methods, 18, 19: 268-80(1962)
17250	17-3026	Dep.(nc); $3.60(fs), $1.13(mf) OTS
17251	17-3967	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17253	17-2950	Dep.(nc); $3.60(fs), $1.37(mf) OTS
17254	17-3268	Dep.(nc); $3.60(fs), $1.16(mf) OTS
17262	17-4106	To be published in TID-7642 Proceedings of the Symposium on Research Reactor Fuel Element, held in Gatlinburg, Tenn., September 17-19, 1962.
17263	17-3013	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17264	17-3072	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17265	17-3073	Dep.(nc); $4.60(fs), $1.58(mf) OTS
17268	17-4338	Dep.(nc); $3.60(fs), $1.37(mf) OTS
17270	17-4339	Dep.(nc); $5.60(fs), $1.73(mf) OTS
17271	17-4340	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17273	17-3027	Dep.(nc); $3.60(fs), $1.19(mf) OTS
17281	17-4341	Dep.(nc); $5.60(fs), $1.73(mf) OTS
17282	17-4342	Dep.(nc); $2.60(fs), $0.95(mf) OTS
17283	17-4155	Nucl. Instr. Methods, 18, 19: 370-7(1962)
17284	17-2926	To be published in TID-7655, Proceedings of the Sixth Conference on Analytical Chemistry in Gatlinburg, Tenn., Oct. 9-11, 1962.
17287	17-2834	$1.60(fs), $0.80(mf) OTS
17288	17-4307	Dep.(nc); $2.60(fs), $0.89(mf) OTS
17290	17-4343	Dep.(nc); $4.60(fs), $1.70(mf) OTS
17292	17-4254	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17295	17-3579	Dep.(nc); $1.60(fs), $0.80(mf) OTS
17297	17-4308	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17306	17-4359	Dep.(nc); $8.60(fs), $3.14(mf) OTS
17307	17-2835	$1.10(fs), $0.80(mf) OTS
17308	17-4344	Dep.(nc); $10.10(fs), $3.83(mf) OTS
17309	17-3014	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17322	17-3387	Dep.(nc); $6.60(fs), $2.24(mf) OTS
17334	17-3491	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17339	17-2951	Dep.(nc); $1.10(fs), $0.80(mf) OTS
17351	17-3542	Dep.(nc); $5.60(fs), $1.97(mf) OTS
17364	17-2952	Dep.(nc); $1.60(fs), $0.80(mf) OTS
TO-B–	**(Non-AEC)**	
60-30	17-2657	See AD-276392
62-13	17-4210	See DASA-1318
TR–	**(Misc.)**	
62-10.4*	17-3368	See AD-275571
62-451.2	17-3487	See SEP-260
TRG-Inf.Ser.–	**(British)**	
239	17-3230	Dep.; $0.42(BIS); 3s.(HMSO)
TRG-Report–	**(British)**	
374	17-3269	Dep.; $0.42(BIS); 3s.(HMSO)
UAC–		
5200	17-3114	See TID-13276
5532	17-4062	See TID-14059
5581	17-4026	See TID-14073
5603	17-3488	See TID-14175
5664	17-2800	See TID-14151
5872	17-2938	See ANL-FGF-318
5880	17-3071	See TID-14891
5904	17-3448	See TID-14889
6709	17-2831	See TID-17198
6749	17-3541	See TID-17211
6756	17-2802	See TID-17200
6793	17-2801	See TID-17191
6810(Pt.2)	17-3578	See TID-17168
6865	17-3417	See ANL-FGF-384
UCLA–		
505	17-2790	Dep.(nc); $1.60(fs), $0.80(mf) OTS
UCRL–		
5695(Pt.4)	17-3917	Phys. Rev. 136: 636-64(1962)
5695-T(Pt.5)	17-3586	Astrophys. J. 136: 665-70(1962)
6329	17-4255	Dep.(nc); $3.60(fs), $1.28(mf) OTS
6357	17-2953	Dep.(nc); $5.60(fs), $1.91(mf) OTS
6400	17-3580	Chem. Rev., 62: 513-48(1962)
6530	17-4063	Dep.(nc); $1.10(fs), $0.80(mf) OTS
6547	17-3270	Dep.(nc); $2.60(fs), $0.89(mf) OTS
6569	17-3492	Dep.(nc); $2.60(fs), $0.95(mf) OTS
6572	17-4177	Dep.(nc); $1.10(fs), $0.80(mf) OTS
6579	17-3581	Dep.(nc); $1.60(fs), $0.80(mf) OTS
6632	17-4178	Dep.(nc); $1.10(fs), $0.80(mf) OTS
6655-T	17-3493	Dep.(nc); $1.10(fs), $0.80(mf) OTS
6657	17-4214	J. Math. Phys. (N. Y.), 3: 1216-28(1962)
6673	17-3960	Dep.(nc); $2.60(fs), $1.07(mf) OTS

Report No.	Abstract No.	Availability
6679	17-3582	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6690	17-4064	Phys. Rev., 128: 2717-23(1962)
6691	17-3231	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6696-T	17-3494	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6752	17-2954	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6800	17-3388	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6839-T(Summ.)	17-2955	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6879	17-4179	Dep.; $2.50(OTS)
6913	17-4097	Phys. Rev. 128: 2345-51(1962)
6919	17-3362	Dep.(mc); $2.60(fs), $0.86(mf) OTS
6946	17-4096	Phys. Rev. 128: 2339-44(1962)
6949	17-3628	Phys. Rev. 128: 2222-4(1962)
7031	17-3271	Dep.; $0.50(OTS)
7035	17-3232	Dep.; $1.25(OTS)
7036(Pt.5)	17-4309	Dep.(mc); $5.60(fs), $1.97(mf) OTS
7046-T	17-4180	Dep.(mc); $2.60(fs), $0.98(mf) OTS
7068	17-3313	Dep.; $1.00(OTS)
7085	17-3272	Dep.(mc); $3.60(fs), $1.37(mf) OTS
7127	17-4256	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9146	17-3649	p.213-16 of "International Tables for X-ray Crystallography (Physical and Chemical Tables), Vol. III." Birmingham, Eng. Kynoch Press, 1962
9304(Rev.)	17-4086	Phys. Rev. 128: 2276-81(1962)
9664	17-3694	Trans. Am. Nucl. Soc. 5: 300(1962)
9699	17-3074	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9726	17-3273	Dep.(mc); $2.60(fs), $1.01(mf) OTS
9774	17-4065	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9791	17-3274	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9792	17-3968	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9796	17-3501	Advan. Chem. Ser. 33: 18-25(1961)
9808	17-3495	$1.60(fs), $0.80(mf) OTS
9828	17-3088	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9840	17-2956	Dep.(mc); $5.60(fs), $1.73(mf) OTS
9885	17-3117	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9887	17-2957	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10013	17-2981	J. Chem. Soc. 2807-13(1962)
10098	17-4088	Phys. Rev. 128: 2288-92(1962)
10275	17-3314	Dep.(mc); $2.60(fs), $0.89(mf) OTS
10294	17-4181	Dep.; $2.50(OTS)
10353	17-4219	Phys. Rev. 128: 2459-61(1962)
10367	17-3713	Trans. Am. Nucl. Soc. 5: 316-17(1962)
10368	17-2768	p.247-52 of Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962
10369	17-2778	p.330-2 of Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962
10370	17-3730	Trans. Am. Nucl. Soc. 5: 330-1(1962)
10371	17-3706	Trans. Am. Nucl. Soc. 5: 309(1962)
10372	17-2771	p.269-73 of Proc. Hot Lab. Equip. Conf., 10th, Washington, D. C., 1962
10373	17-3729	Trans. Am. Nucl. Soc. 5: 329-30(1962)
10378	17-3969	Dep.; $2.00(OTS)
10415	17-3496	Dep.; $1.50(OTS)
10440	17-4211	Dep.(mc); $1.10(fs), $0.80(mf) OTS

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UCRL-Trans.–		
599(L)	17-2960	Dep.(mc); $2.60(fs), $1.04(mf) ICL
840(L)	17-3238	Dep.(mc); $1.60(fs), $0.80(mf) ICL
UNC-Memo–		
5039	17-4257	Dep.(mc); $2.60(fs), $0.92(mf) OTS
UR–		
618	17-2836	Dep.; $10.10(fs), $3.89(mf) OTS
USBM-U–	**(Misc.)**	
978	17-3389	Dep.; $0.50(OTS)
USNRDL-TR–	**(Non-AEC)**	
570	17-3233	OTS
585	17-3234	$2.60(OTS)
586	17-3315	
VDIT–	**(Swedish)**	
16(2.3)	17-3543	
43	17-3235	
64	17-3236	Dep.(mc)
WADC-TR–	**(Non-AEC)**	
53-373(Suppl.8)	17-3390	$3.50(OTS)
59-603(Pt.III)	17-3497	OTS
59-762(Pt.IV)	17-3498	OTS
WADD-TR–	**(Non-AEC)**	
61-72(Vol.VIII)	17-2958	OTS
61-72(Vol.X)	17-3015	OTS
61-72(Vol.XI)	17-3449	OTS
61-181(Pt.II)	17-3499	OTS
WAL-TR–	**(Non-AEC)**	
823/3	17-2906	$0.50(OTS)
823.5/1	17-2907	$0.50(OTS)
WAPD-T–		
1211	17-3363	Dep.(mc); $3.60(fs), $1.25(mf) OTS
1270	17-3275	$8.10(fs), $2.72(mf) OTS
1280	17-4372	Dep.(mc); $2.60(fs), $0.95(mf) OTS
1531	17-3364	Dep.(mc); $1.10(fs), $0.80(mf) OTS
WCAP–	**(Misc.)**	
1373	17-3961	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WT–	**(Misc.)**	
547*	17-2666	Dep.(mc); $6.60(fs), $2.03(mf) OTS
560*	17-2667	Dep.(mc); $2.60(fs), $0.98(mf) OTS
Y–		
1402	17-3316	Dep.; $0.50(OTS)
1405	17-3237	Dep.; $0.50(OTS)
1406	17-2908	Dep.; $0.50(OTS)